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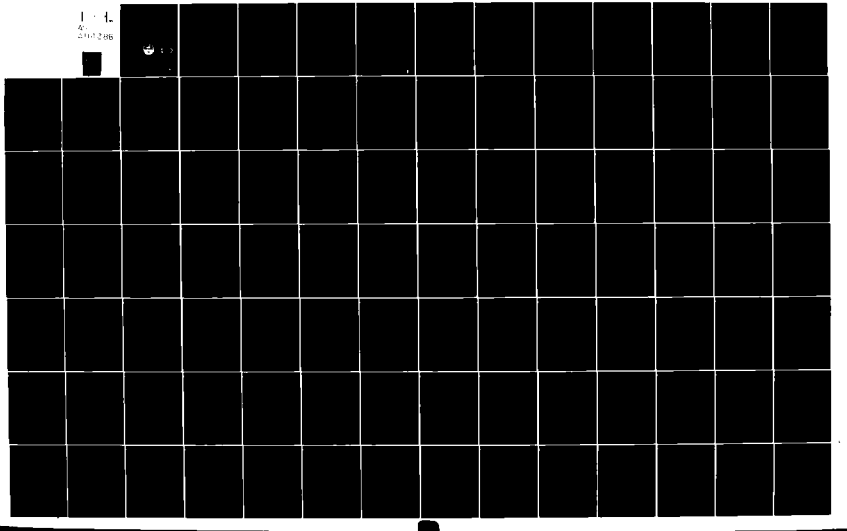

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NAVY PERSONNEL RESEARCH
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NAVY JOB-RELATED MALE-FEMALE DIFFERENCES: ANNOTATED BIBLIOGRAPHY

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This bibliography presents the results of a literature review to identify areas in which research has shown males and females to differ significantly and reliably and that might account for male-female performance differences on Navy jobs traditionally held by men. The long-range objective of the project was to identify principles for job design for equal performability by men and women.

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FOREWORD

This effort was conducted under exploratory development program element 62757N (Human Factors and Simulation Technology). It was performed in response to the concern of ADM J. A. Winnefield, Assistant Chief of Personnel Planning and Programming (OP-12). He indicated that, since human factors engineering has been based exclusively on male samples, and increasing numbers of women are entering the Navy, job and equipment design standards should be developed that are compatible to both sexes.

In this effort, the pertinent research literature was reviewed to determine whether there are practical, reliable differences in the performance of males and females in Navy jobs. If the general principles of male-female work performance can be identified, they can be used to develop a human factors guide for job design/redesign for women in Navy jobs.

Results should be of interest and use to the research community and those agencies and offices concerned with equal opportunity matters and the employment of women on work traditionally performed by men.

JAMES F. KELLY, JR.
Commanding Officer

JAMES J. REGAN
Technical Director

SUMMARY

Problem

The U.S. Navy is committed to the principle of Equal Employment Opportunity and has been noted for its efforts to eliminate discrimination on the basis of race and religion. The elimination of discrimination has now been extended to that based on sex. Increasing numbers of women are being assigned to an increasing number and variety of jobs previously performed solely by men. The Navy, like most military organizations throughout the world, has been a predominantly male domain, and its jobs have evolved for or have been designed to be performed by men. Since males and females may differ inherently on a variety of characteristics and capabilities, the requirements of these jobs, "nontraditional" for women, may place undue and unnecessary demands upon women, compared with men. Such demands need to be identified so that the jobs might be redesigned, if feasible, to eliminate or minimize them.

Objective

As a first step in addressing the above problem, the objective of this effort was to identify those characteristics on which males and females consistently have been demonstrated to differ significantly. Emphasis was on those characteristics shown to exist between males and females within the general age range represented by first and second enlistment Navy personnel.

Approach

The professional literature published during the past 20 years was reviewed. The review emphasized experimental research directed purposively at male-female differences, employing subjects in the general age range of 17 to 30 years, and involving some characteristic, trait, or ability that had a potential relationship to some feature of a Navy job that could be modified by job design. Report abstracts were prepared, grouped according to topical content, and are presented in an annotated bibliography format.

Results

The primary male-female differences of major import for job design are physical ones, principally anthropometric measurements including weight and strength. Cognitive differences between males and females are not as clearly defined as are physical differences. The most well established cognitive differences occur in the areas of spatial and verbal abilities, with males tending to be superior in the former and females in the latter. Differences on these and other cognitive factors, however, tend to be small, show considerable overlap, and account for only very minor proportions of total variance. Arguments have also been raised over whether various cognitive differences are truly inherent or are the result of sociocultural influences such as male-female roles, experience opportunities, self-perceptions, aspirations, and so forth.

Conclusions

Male-female differences in anthropometric measurements, weight, and muscular strength appear to be the only ones potentially likely to result in practicable performance differences between men and women on Navy jobs. Other inherent differences show little promise in accounting for performance difference of any practical significance.

CONTENTS

INTRODUCTION

Problem

Increasing numbers of women are being assigned to an increasing number and variety of Navy jobs both aboard ship and ashore. Most Navy jobs, however, have traditionally been held by men. They have been performed solely by men and have evolved from or have been designed for performance by men. Since men and women may differ significantly in a variety of characteristics and capabilities, the requirements of these jobs, "nontraditional" for women, may place undue and unnecessary demands upon women, compared with men. Such demands should be identified and, insofar as feasible and practicable, the jobs should be redesigned to eliminate or minimize them. To accomplish this, it is necessary to (1) identify job-relatable characteristics and capabilities on which men and women inherently differ, (2) identify jobs with characteristics that are likely to result in significant male-female performance differences attributable to inherent gender differences, (3) examine those jobs to determine whether there really are differences in the performances of men and women assigned to them, and (4) determine how the performance differences can be eliminated.

Objective

The objective of this effort was to identify those characteristics on which males and females differ significantly and that might be related to some factor of Navy jobs subject to modification by job design.

APPROACH

Standard bibliographic publications, computerized bibliographic data banks, and existing published bibliographies were examined to develop a preliminary listing of potential references. Libraries at the Navy Personnel Research and Development Center, Naval Health Research Center, Naval Ocean Systems Center, University of California at San Diego, and San Diego State University were thoroughly searched for references and also for more recent reports in the journals in which the references appeared. Insofar as possible, reports were reviewed as published. If the report was not available, abstracts of the reports from secondary sources were reviewed.

Five major considerations guided the selection of reports:

1. The research was designed purposely to determine whether males and females do or do not differ on some characteristic, trait, or ability.

2. The report presented the results of experimental research, preferably including a statement of the statisical significance of findings.

3. The research employed subjects within the age range of about 17 to 30 years--the age range most likely to be represented in the traditionally male Navy jobs now accessible to females.

4. The characteristic, trait, or ability had a potential relationship to some modifiable feature of a Navy job.

5. The research was reported within approximately the last 20 years.

An abstract was prepared for each usable report. Insofar as possible, the abstract included the number of subjects by sex, ages, and other identification; procedures employed; and the conclusions or results obtained. Abstracts were then grouped into one or more topic clusters based on their detailed content. A single report could thus appear in two or more clusters. Finally, summaries of the results presented in the reports in each cluster were prepared to identify the patterns of differences reported for that cluster.

RESULTS

Annotated Bibliography

Results are presented in the annotated bibliography in the appendix under the following topics:

- Anthropometry
- Fitness
- Strength
- Coordination
- Reaction time
- Audition
- Vision
- Brain/handedness laterality
- Intelligence/general academic ability
- Spatial ability
- Verbal ability
- Problem solving
- Psychomotor
- Perception/discrimination
- Short-term memory
- Field dependence
- Literature reviews

A summary in the form of a frequency table noting the number of times a specified difference or lack thereof was reported among the included reports is provided at the end of each topic. The purpose of these summaries is to provide a quick view of the sex differences noted in the cited reports.

General Summary

The research literature summarized in this report generally supports the findings of other researchers (e.g., Bittner & Moroney, 1978; Garai & Scheinfeld, 1968) that the primary male-female differences of major import for job design are physical. Topic areas are discussed in the following paragraphs.

Anthropometry

Males are larger in most dimensions, heavier, and stronger than are females. Dimensional differences can have important impacts on clothing, tool, and equipment design (Bolalek & Grumblatt, 1975; Bruno, 1979; Ducharme, 1978). Glumm (1976) observes that even minor variations in size or proportion can be critical. Dimensional differences, such as height or functional arm or leg reach, can also be important factors in work space and console layout. For example, Karim, Bergey, Chandler, Hasbrook, Purswell, and Snow (1972) demonstrated that the range of adjustments available in an operator's seat is insufficient to accommodate many females. Asfour, Ayoub, Mital, and Bethea (1978) have shown that there are dynamic differences between male and female reach envelopes that may affect their ability to manipulate various controls.

An individual's body weight, in and of itself, is likely to be of minimal importance for the performance of many Navy tasks. In conjunction with strength, however, it can be critical. In any mass-versus-mass or tug-of-war type task, the heavier individual will have an advantage over the lighter. In carrying-type tasks, the heavier individual will also have an advantage over the lighter in terms of the ratio of the weight carried to total body weight, as Glumm (1976) points out. A given load weight thus will be an effectively greater burden for a lighter than heavier individual.

Strength

The muscular strength of females has been found to be consistently less than that of males, with female total strength averaging about 65 percent of that for males. However, depending on the muscle or muscle group tested, the nature of the task, and the measurement used, female strength ranges from about 35 percent to 85 percent that of males. Thus, the significance of male-female strength differences for task performance will depend upon the specific strength requirements of the task. The real question is whether females are strong enough to satisfy the strength requirements of the specific task without undue difficulty.

Audition

Females generally have better auditory acuity than do males, especially at the higher frequencies (Garai & Scheinfeld, 1968; McGuiness, 1972). They also tend to perceive a given sound as louder than do males (McGuinness, 1972). While males have greater loudness tolerance than do females (McGuinness, 1974), there is some evidence (Smith, 1969) that females' hearing is better protected than is males'. Thus, females may have an advantage over males on tasks requiring auditory acuity. Some sort of sound attenuation may be required, however, for females to perform without discomfort in noisy environments.

Vision

In the area of vision, neither sex seems to be clearly superior to the other. Males may have a slight advantage in both static and dynamic acuity. Females may have a slight advantage in autokinesis and after-image, being possibly less susceptible to both.

Coordination

Males and females differ in bodily coordination, males tending to be superior on fast, gross body movements and females tending to be superior on fine manual or motor movements. Thus, females may have an advantage over males on some tasks. Whether their relative inferiority in gross body coordination is great enough to produce a significant difference in performance appears to be questionable.

Fitness

There appears to be some differences in the physiological responses of males and females to work and temperature, although the research findings are not entirely consistent. Female aerobic power averages about 70-75 percent that of males (Astrand & Christensen, 1964; Brouha, 1962). Males perspire more and begin perspiring at lower skin temperatures and lower deep body temperatures than do females (Fox & Löfstedt, 1968; Morimoto, Slabochova, Naman, & Sargent, 1967). Females generally have higher heart rates than do males while performing work under moderate to hot and dry to humid conditions (Brouha, Smith, DeLanne, & Maxfield, 1960; Stephens, 1978; Wells & Horvath,

1974). Brouha et al. (1960) and Burse (1979) conclude that heat produces greater cardiac stress in females than in males. Burse also concludes that females are less capable of adapting to cold than are males and run greater risk of injury from cold. Female aerobic power can be improved (Daniels, Kowal, Vogel, & Stauffer, 1979; Vogel, Ramos, & Patton, 1977) and heat tolerance can be increased (Gisolfi & Cohen 1979) by training. Training given to both sexes does not, however, materially reduce the differences between them.

Brain/Handedness Laterality

Males and females have been shown to differ in the manner in which their brains process information (Ray, Morell, Frediani, & Tucker, 1976). Males generally exhibit greater specialization of functions performed by each of the two hemispheres of the brain while females exhibit greater sharing of function between the two hemispheres (Bradshaw, Gates, & Nettleton, 1977; Buffery, 1976; Davis & Wada, 1978). This difference in brain lateralization has been used to explain male spatial superiority and female verbal superiority (e.g., Bradshaw & Gates, 1978; McGlone & Kertesz, 1973). Male-female differences in brain lateralization do not, however, appear to have any direct applicability for job design. Insofar as they may have an effect on job performance, it seems likely that the effect will be evidenced indirectly as through spatial or verbal performance differences.

Intelligence/General Academic Ability

No clear, consistent differences in intelligence or general academic ability appeared between males and females. Some differences were shown for certain components such as spatial and verbal abilities. There was some indication of male superiority on mathematics, especially, for example, arithmetic reasoning. The reports, however, were too few and varied to provide a clear pattern. Differences on separate components of intelligence are covered under individual topics.

Spatial and Verbal Abilities

Such cognitive differences that do exist between males and females are generally not as clear-cut or consistent as are the physical differences. The most well established differences are those in the areas of spatial and verbal abilities. Of the 30 citations included in the spatial abilities bibliography, only five failed to report male superiority in spatial ability: Fennema and Sherman (1977), Groberg, Dustman, and Beck (1969), Hartlage (1970), Pitblado (1976), and Sherman and Fennema (1978). Sherman (1978) notes that sex-related differences were small and that there was considerable overlap in the distributions. This suggests that spatial abilities may be influenced by sociocultural factors or, as Sherman (1967) speculated, spatial abilities differences may be the result of differential sex-role or sex-stereotype experiences. Also, Harris (1978) suggests that spatial skills are trainable and that female performance levels might be brought up to those of males with appropriate training.

Female superiority over males in verbal ability was reflected in the verbal abilities bibliography and appears to be as well established as male superiority in spatial ability. Seven reports found significant female superiority in one or another aspect of verbal performance while three found no sex differences. Only two reported male superiority. Males score higher on the verbal subscale of the Wechsler-Bellevue, but there were no sex differences on either the full-scale or performance subscales (Reese & Palmer, 1970). Backman (1972) found that males scored higher than did females on a verbal knowledge test. He noted, however, that the test was heavily loaded with sports, military, and electronics items, suggesting that social or cultural influences may have been operating.

Although male-female differences in spatial and verbal abilities are found rather regularly and are generally statistically significant, Sherman (1978) notes that, typically, the sex differences account for a very small proportion of the total variance, about 4 percent or less in the case of spatial ability and, at least in one example, less than 1 percent in the case of verbal ability.

Problem Solving

No clear pattern of male or female superiority in the area of problem solving or reasoning emerged from the literature. Males do appear to be clearly superior solvers of problems of the type found in the problem-solving literature (e.g., the "Horse Trading Problem," the "Train Problem" or the "Nine-Dot Problem"). In attacking problems, females tend to use less efficient strategies than do males (Allen, 1974) and to use concrete or unorganized strategies, skip problems, or give up (Allen & Hogeland, 1978). An attitudinal factor may be influencing these sex differences, however. Carey (1958) found that males initially had a more positive, favorable problem-solving attitude than did females and performed better on problem-solving tasks. After a pro-problem-solving discussion, females' performance improved, males' did not, and the sex differences in performance disappeared. Aside from those reports dealing with more or less "trick" problems, only two studies addressed differences in reasoning. Very (1967) found that females scored higher than did males on logical reasoning and males scored higher than did females on arithmetic and general reasoning. Hoffman and Maier (1966) found that males scored significantly higher than did females on both logical and arithmetic reasoning. When they controlled for mathematics aptitude, however, the differences dropped so they were no longer statistically significant.

Psychomotor and Reaction Time

The psychomotor topical bibliography shows that males are clearly superior to females on rotary pursuit, choice reaction, and eye-tracking tasks. Females appear to be superior to males on simple reaction tasks. There are, of course, overlaps between the male and female distributions and it remains to be determined whether these differences have practical significance in the "real world" of Navy performance.

Field Dependence

Sex differences in "field dependency" has attracted a good deal of research. Field dependency is defined by Hoyenga and Hoyenga (1979) as "the inability to ignore irrelevant stimuli in making judgments, particularly in spatial tasks. Tests of this include the rod-and-frame task (RFT) and the embedded figures task (EFT)." Indeed, field dependency appears to have come to be operationally defined by performance on these two tests in one or another of their various forms. The ability to ignore irrelevant stimuli (i.e., field independence) might have importance in a variety of Navy jobs. The literature review encompassed 24 reports incorporating the RFT or the EFT or both. Of these, five showed male superiority on the RFT and six, male superiority on the EFT. Six showed no significant RFT sex differences and five, no EFT sex differences. In one additional report (Hyde, Geiringer & Yen, 1975), male superiority was found on the RFT but not on the EFT. However, when spatial ability was controlled, the male superiority disappeared and females became superior on the EFT. Two other studies (Goldstein & Chance, 1965; Chance & Goldstein, 1971), found that males were superior to females on the first 10 items of a 34-item EFT but that there were no sex differences on the last 10 items of a second 34-item ETF administered 48 hours later. They concluded that practice dissipates initial EFT performance differences and thus field independency may be trainable. Sherman (1974) found that RFT performance was significantly affected by practice, with

no sex differences in overall performance. Males, however, made larger errors when the frame was tilted to the left; and females, when the frame was tilted to the right. The only significant male-female difference found by Pitblado (1977) was the systematic setting of the rod to the left of vertical by males and to the right of vertical by females. Walker (1972), in using a grid and rotatable bar to examine visual and tactual field dependence, found that males were significantly more accurate on the visual task but that there were no differences on the tactual task. In a pair of studies, one employing female subjects and the other male, Vaught and Auguston (1967) used RFT performance as the means of assigning subjects to one of three field dependency groups. They compared the performance of these groups on their performance of a form discrimination task. They found that field-independent males made significantly fewer errors than did field-dependent males, but that field-independent females made significantly more errors than did field-dependent females. It appears that any job redesign on the basis of male-female field dependency differences would need to be approached with special caution.

Short-term Memory

Field dependency research findings above were about equally divided between those showing male superiority and those reporting no sex differences. Short-term memory findings are somewhat similarly distributed except that where differences were reported they generally, but not invariably, favored females. Over half of the short-term memory results, however, showed no sex differences.

Perception/Discrimination

Perception discrimination research generally found no sex differences. About the only factors on which there appear to be sex differences are visual form perception and visual autokinesis, both of which favor females.

DISCUSSION AND CONCLUSIONS

Results indicate that male-female differences in the anthropometric, weight, and strength areas are the most clear-cut and firmly established. They also appear to offer the greatest prospects for accounting for major differences in the performances of men and women on Navy jobs. Research has demonstrated other male-female differences that may be potential sources of differences in job performance. These, however, are generally of less magnitude and are found less consistently. Several considerations, individually and in combination, appear to mitigate against the likelihood of observing practically significant job performance differences attributable to these latter male-female differences and, to a greater or lesser extent, even the primary differences.

The subjects used in the cited research, especially in the cognitive areas, were usually college students, typically sophomores in undergraduate psychology courses. College entrance and continuance, however, involves a variety of selective screening factors that may make college students atypical of and noncomparable to Navy enlisted personnel of the same general age. This appears more likely for males than females because of differential recruitment policies for the two sexes. Differences found in a college population may therefore not appear or may be larger or smaller in the Navy population.

Within the Navy, entrance into a rating requires that individuals meet certain minimum, presumably job-related, qualifications. Thus, the capabilities of persons within a rating can be expected to be more homogeneous than in the general population and any

differences between males and females may be less. Insofar as rating-related training is directed toward attainment of some standard proficiency level, performance differences among men and women are likely to be reduced even further.

Even if there is a significant difference between the capabilities of males and females on the job, a noticeable job performance difference cannot automatically or necessarily be expected. The probability of an observable performance difference will be, in part, dependent on the magnitude of the demand for a capability and the placements and overlaps of the male and female distributions for that capability. If both sexes generally possess "enough" of a capability to satisfy the work requirements, as there is some basis for suspecting in many cases, an observable or meaningful difference may not be elicited. Further, many of the cited reseach reports failed entirely to address the issue of variability within the male and female distributions. In others, sufficient information was given to indicate that considerable overlap may be the rule rather than the exception. If this is the case, any sex-related performance differences attributable to sex differences in the capability may be very difficult to identify apart from ordinary individual differences.

Finally, any operative performance differences between males and females must be observable against a background of many and complex conditions and interactions existent in the work environment. The noted male-female differences were identified from research that generally tried, appropriately, to control contaminating variables to a greater or lesser extent. However, such contaminating factors are an inherent part of the actual work situation. Tasks are typically less specific and well defined, more wholistic and complex, than in the research setting; are subject to a variety of external influences; may allow for alternate means of performance; often call for joint or cooperative performance by two or more individuals, and so on. Many of the established male-female differences appear to be relatively small, are not consistently demonstrated and, although statistically significant, account for only a minor portion of the total variance in some cases. Therefore, it seems highly unlikely that many practical performance differences attributable confidently to inherent sex differences will be observable in the work environment.

Job factors and their interactions may, however, produce cumulative effects resulting in greater and more significant performance differences than might otherwise be expected. The absence of practically significant performance differences between men and women on the job cannot, therefore, necessarily be assumed but, rather, should be verified.

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Sherman, J. A. Problem of sex differences in space perception and aspects of intellectual functioning. Psychological Review, 1967, 74(4), 290-299.

Sherman, J. A. Field articulation, sex, spatial visualization, dependency, practice, laterality of the brain and birth order. Perceptual and Motor Skills, 1974, 38, 1223-1235.

Sherman, J. A. Sex-related cognitive differences: An essay on theory and evidence. Springfield, IL: Charles C. Thomas, 1978.

Sherman, J. A., & Fennema, E. Distribution of spatial visualization and mathematical problem solving scores: A test of Stafford's X-linked hypotheses. Psychology of Women Quarterly, 1978, 3, 157-167.

Smith, P. E., Jr. A test for susceptibility to noise-induced hearing loss. American Industrial Hygiene Association Journal, 1969, 30(3), 245-250.

Stephens, R. Observations on women working under thermal stress. Proceedings of the Human Factors Society--22nd Annual Meeting--1978, 240-242.

Vaught, G. M., & Auguston, B. Field-dependence and form discrimination in females. Psychonomic Science, 1967, 75, 169-207.

Very, P. S. Differential factor structures in mathematical abilities. Genetic Psychology Monographs, 1967, 75, 169-207.

Vogel, J. A., Ramos, M. U., & Patton, J. F. Comparisons of aerobic power and muscle strength between men and women entering the U.S. Army. Medical Science in Sports, 1977, 9, 58. (Abstract)

Walker, J. T. Tactual field dependence. Psychonomic Science, 1972, 26, 311-313.

Wells, C. L., & Horvath, S. M. Metabolic and thermoregulatory responses of women to exercise in two thermal environments. Medicine and Science in Sports, 1974, 6(1), 8-13.

APPENDIX

ANNOTATED BIBLIOGRAPHY OF NAVY JOB-RELATED MALE-FEMALE DIFFERENCES

CONTENTS

ANTHROPOMETRY

Asfour, S. S., Ayoub, M. M., Mital, A. & Bethea, N. J. Reach Profiles for males and females under restrained and unrestrained conditions. Proceedings of the Human Factors Society--22nd Annual Meeting--1978. pp 671-675.

Twenty-five males, ages 18-42, and 24 females, ages 18-22 years, were measured for altitudinal reach using the Ayoub Reach Anthropometer. Body restraint decreased reach for both males and females. The unrestrained reach of females was about 10 cm. less than that of males for altitudes of 0^{o} or greater. Below 0^{o} the difference lessens and disappears at about -45^{o}.

Bittner, A. C., Jr. & Moroney, W. F., LCDR. Computer-Aided Anthropometric Evaluation of Workplace Designs for Women-Related Investigations. In Minutes of the Tenth Training and Personnel Technology Conference (TPTC) held 16 February 1978. Human Factors Engineering Branch, Pacific Missile Test Center, Point Mugu, CA.

A literature review was conducted, from which it was concluded that male-female physical differences in anthropometry, muscle strength, etc., provided the only source of major impact on human factor engineering design. Data on selected male-female differences are presented.

Bolalek, P. J. & Grumblatt, A. G., Jr. A study to determine the adequacy of the tools and equipment used by Air Force women in the craft skills. Report No. SLSR-14-75A, Air Force Institute of Technology Wright-Patterson Air Force Base, OH, 1975.

Fourteen hundred USAF females working in craft skills completed a self-administered questionnaire asking for anthropometric data and an evaluation of tools and equipment with reasons for inadequacies. Crimping tools, wire strippers, soldering irons, goggles, work uniforms and work shoes were rated inadequate by at least 10% of respondents. Mean age of respondents was 21.48 years, height 64.85 in., weight 126.82 lbs., and hand length 6.93 in.

Bruno, R. S. Human factors evaluation of male field clothing ensembles worn by female soldiers (hot-dry, hot-wet, and cold-wet environments) (Rept. No. HEL-TN-5-79). Human Engineering Labratory, Aberdeen Proving Ground, MD, August 1979. (AD-B401 4636)

Fifteen female soldiers, ages 18-23 years, performed selected exercises while wearing a variety of Army male clothing and equipment and reported difficulties. Subjects' comments demonstrated that there are complex effects of male-female size-proportion differences. Some male equipment sizes can be used directly by females; other equipment needs to be adapted to a greater or lesser extent. Some male equipment, e.g., M1 helmet, is not well-sized, even for males.

Dill, D. B., Myhre, L. G., Greer, S. M., Richardson, J. C. & Singleton, K. J. Body composition and aerobic capacity of youth of both sexes. Medicine and Science in Sports, 1972, 4, 198-204.

Eleven male and 10 female students, ages 15-20 years, were measured for body composition and aerobic capacity. Significant ($p<.05$) differences were found in body dimensions and composition between males and females. Aerobic capacity and related measurements showed males significantly ($p<.05$) superior to females.

Ducharme, R. E. Preplanning the integration of women into the workforce. Proceedings of the Human Factors Society--22nd Annual Meeting--1978. 235-239.

Fourteen hundred USAF women in skilled craft jobs were surveyed by interviews and questionnaires. The conclusions were that there are both common and job specific tools and equipment that are inadequate for use by women, that tools and equipment should be modified for use by a wide range of personnel as a short-range solution, that jobs should be redesigned as a medium-range solution, and that future systems should be designed with women operators and maintenance in mind as a long-range solution.

Garrett, J. W. The adult human hand: Some anthropometric and biomechanical considerations. Human Factors, 1971, 13, 117-131.

Presents 5 tables of measurements of male and female hands plus a table of anthropometry of the hand: Bare, unpressurized gloved, pressurized gloved.

Glumm, M. M. The female in equipment design. Automatic Engineering Congress and Exposition. Detroit, MI, February 23-27, 1976. No. 760078.

Discussion paper. Anthropometric data has, in the past, focused on the 5th to 95th percentile male. In a number of critical measurements, the 5th percentile female falls below the 1st percentile male. Even minor variations can be critical to the efficient and safe usage of equipment and protective gear. The infantry man is not expected to lift and carry loads over one-fourth his own body weight, yet present load bearing systems place loads approximating one half females' body weight distributed on shoulders and breasts.

Glumm, M. M. The female in military-equipment design. U. S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD. Technical Memorandum 13-76. April 1976. AD-B012 107.

(Report on which above presented paper was based) Demonstrates that anthropometric measurements are not necessarily static but change, some significantly, over a period of years, even less than a decade.

Grasley, C., Ayoub, M. M. & Bethea, N. J. Male-female differences in variables affecting performance. Proceedings of the Human Factors Society--22nd Annual Meeting--1978, 415-420.

Literature review of physical differences literature concludes that there are male-female differences in general anthropometric values but specific body part data are needed; biomechanical sex difference data are less clear cut, with findings inconsistent, variable, or specific to conditions; and that physiological similarities outweigh differences, with large areas of overlap.

Kaplan, M. C. & Knutson, S. J. Human factors analysis of women working in industrial environments. Proceedings of the Human Factors Society--22nd Annual Meeting--1978, pp 243-245.

Analysis of industrial accidents in Wisconsin, 1975-1976, revealed that too-large gloves contributed to female accidents by getting caught in machinery or impeding use of controls such as emergency out-off switches. There were no standards for women's safety shoes, which were not readily available but were often expensive, ill fitting and inadequately designed for use in certain operation's such as foundry work. Personal protective equipment, such as goggles, face shields, clothing, gloves, hardhats and respirators, were ill fitting and therefore inadequately effective. The weight, size, and proportions of many tools and the design of some machines disregarded female needs.

Karim, B., Bergey, K. H., Chandler, R. F., Hasbrook, A. H., Purswell, J. L. & Snow, C. C. A preliminary study of maximal control force capability of female pilots. FAA-AM-72.27. Department of Transportation, Federal Aviation Agency. Office of Aviation Medicine. Washington, DC 20591, 1972.

Twenty-five female pilots were studied in a wooden "cockpit" equipped with strain gages. Maximum force levels allowed by current regulations may be too high for a portion of the female population. General aviation cockpits do not accommodate the range of seat, wheel, and rudder control adjustments needed by many female pilots.

Levy, J. & Levy, J. M. Human lateralization from head to foot: Sex-related factors. Science, 1978, 200, 1291-1292.

Fifty-two male (17 under age 6) and 98 female (18 under age 6) shoe customers in a department store were interviewed on handedness and had their feet measured. There was a significant ($p < .0001$) relationship between sex and foot asymetry of right-handed subjects with males having larger right than left feet and females having larger left than right feet. There was a significant ($p < .0001$) relationship in the opposite direction between sex and foot asymetry for left-handed subjects.

Roozbazar, A. Workplaces for short people, tall people, or both. Industrial Engineering, 1978, 10(7), 18-21.

Provides table to adapt anthropometric measurements of a group to a work space, giving 18 anthropometric parameters in terms of fractions of stature separately for 5th 50th and 95th percentile males and females.

Snook, S. H. & Ciriello, V. M. Maximum weights and workloads acceptable to female workers. Journal of Occupational Medicine, 1974, 16(8), 524-534.

Sixteen housewives and 15 female industrial workers performed a variety of weight-force tasks and results were compared with indentical measurements using male industrial workers. Anthropometric measurements of industrial males were all, except for lower extremities, significantly ($p < .10$) greater than for industrial females.

Staff, Anthropology Research Project. Anthropometric Source Book Vol I: Anthropometry for Designers; Vol II: A Handbook of Anthropometric Data; Vol III: Annotated Bibliography of Anthropometry. Webb Associates, Yellow Springs, OH 45387. (National Aeronautics and Space Administration Reference Publication 1024 July 1978).

Encompasses virtually all the anthropometric and biomechanical data available at the time of publication. A large number of data source populations, both male and female, are represented. Articles on various applications of the data are provided.

White, R. M. Anthropometry of women of the U. S. Army. Proceedings of the Human Factors Society--22nd Annual Meeting--1978, pp 456-460.

Measurements of 6677 male and 1331 female Army personnel demonstrated that 44% of the females were below the 5th percentile of males in sitting height, 80% were below the male 5th percentile in functional arm reach, and 62% were below the male 5th percentile in functional leg length.

White, R. M. The anthropometry of United States Army men and women: 1946-1977. Human Factors, 1979, 21(4), 473-482.

Presents statistical data on U.S. Army males and females obtained in 1946 and in 1966 (males) and 1977 (females). Data are presented for kg. weight and cm. stature, sitting height, chest/bust circumference, waist circumference and hip circumference, as well as age. Mean, standard deviation, minimum, maximum, and total range data are given, as are values for the 1st, 5th, 25th, 50th, 75th, 95th and 99th percentiles.

ANTHROPOMETRY SUMMARY

1. Extensive anthropometric measurement data are available for both male and female populations.

2. Males are consistently larger than females on most measurements.

3. The extent and shape of male and female measurement differences vary greatly with varying degrees of overlap.

4. Current equipment may not permit a great enough range of position adjustment to accommodate a large proportion of females.

5. Complex effects of male-female size-proportion differences may make even small dimensional diffferences critical to the safe, efficient use of equipment and gear.

FITNESS

Asmussen, E. & Heeboll-Nielson, K. Isometric muscle strength in relation to age in men and women. Ergonomics, 1962, 2, 167-169.

Three-hundred-sixty males and 250 females, ages 15-60 years, were measured for maximal aerobic capacity and isometric muscle strength of arms and legs. Male strength increases to age 30, female to age 20. Aerobic capacity decreases more, and more rapidly, than skeletal muscle strength as a function of age.

Astrand, P. O. & Christensen, E. H. Aerobic Work Capacity. In Oxygen in the Animal Organism, Dickens, F., Neill, E. & Widdes, W. F. (Eds), Pergamon Press, New York, 1964.

Three-hundred-fifty individuals, ages 4-65 years, in normal health and physical condition were measured for aerobic capacity during treadmill or bicycle ergometer exercise. No sex differences until puberty. Both sexes peak at about 18-20 years. Females average 70-75% that of males. Female mean values coincide closely with male -2SD line.

Astrand, P.O, Cuddy, T. E., Saltin, B. & Stenberg, J. Cardiac output during submaximal and maximal work. Journal of Applied Physiology, 1964, 19, 268-274.

Twelve males and 11 females, ages 20-31 years, were tested on a variety of cardiac measures at rest and while performing maximal and submaximal work. Females had a higher cardiac output per liter of oxygen uptake than males during maximal and submaximal exercise.

Ayoub, M. M. & Manuel, R. R. A physiological investigation of performance rating for repetitive type sedentary work. Journal of Industrial Engineering, 1966, 16(7), 366-376.

Eight males and eight females, ages 18-22 years were measured for pulmonary ventilation rate while seated at rest. No significant differences were found.

Eighteen males and 18 females in each of 3 age groups: 18-22 years, 28-32 years, 37-43 years, were measured for pulmonary ventilation while dealing cards or filling pegboard at 80%, 100%, and 110% of standard rate. Females had significantly lower ventilation rate per body surface area than males.

Brouha, L., Smith, P. E., DeLanne, R. & Maxfield, M. E. Physiological reactions of men and women during muscular activity and recovery in various environments. Journal of Applied Physiology, 1960, 16, 133-140.

Six males, ages 30-58 years, and 5 females, ages 20-38 years, performed a standard exercise under three temperature-humidity conditions. Pulmonary ventilation, oxygen consumption, carbon dioxide elimination, heart rate, blood pressure, body temperature and weight loss were recorded. Cardiac cost increased and efficiency decreased in warm environments significantly more in females than males. Heart rates for females in warm humid conditions were significantly higher for females than males.

Brouha, L. Physiology of training, including age and sex differences. Journal of Sports Medicine and Physical Fitness, 1962, 2, 3-11.

(Not a research report.) Males and females differ in their physiological capacity to perform exercise. Female heart rate is higher than that for males at a given oxygen consumption level. Finale aerobic capacity averages 25-30% less than males.

Coles, M. G. H., Porges, S. W. & Duncan-Johnson, C. C. Sex differences in performance and associated cardiac activity during a reaction time task. Physiological Psychology, 1975, 3(2), 141-143.

Ten male and 10 female college students, ages 18-21 years performed reaction time task while heart rate was measured. Males showed non-significantly slower heart rate and non-significantly greater heart rate variability than females.

Cote, R. W., III., Bomar, J. B., JR., Robertshaw, G. E. & Thomas, J. C. Maximal aerobic power in women cadets at the U. S. Air Force Academy. Aviation, Space and Environmental Medicine, 1977, 48(2), 154-155.

A stratified sample of 17 female cadets were selected from the USAF Academy class of 1980 for extensive measurement. The cadets were judged to be above civilian contemporaries and well above college coeds in circulatory fitness.

Daniels, W. L., Kowal, D. M., Vogel, J. A. & Stauffer, R. M. Physiological effects of a military training program in male and female cadets. Aviation, Space, and Environmental Medicine, 1979, 50, 562-566.

Thirty male and 30 female USMA entering cadets, ages 17-21 years, were tested at beginning and end of 6 week training program. Females showed a significant improvement in aerobic power, males did not. The initial difference of 22% was reduced to 18%.

Dill, D. B., Myhre, L. G., Greer, S. M., Richardson, J. C. & Singleton, K. J. Body composition and aerobic capacity of youth of both sexes. Medicine and Science in Sports, 1972, 4, 198-204.

Eleven males and 10 females, ages 15-20, Caucasian non-smoking, non-overweight were measured for body composition and pulmonary functioning. Males were significantly superior to females on aerobic capacity and related measurements.

Dyer, K. F. The trend of the male-female performance differential in athletics, swimming and cycling 1948-76. Journal of Biosocial Science, 1977, 9, 325-338.

Top performances by males and females in three competitive sporting events from 1948 to 1976 were examined. If observed improvements in female performance continues, it should equal that of males in the three events sometime in 21st Century.

Elliott, P. R. & Atterbom, H. A. Comparison of exercise responses of males and females during acute exposure to hypobaria. Aviation, Space, and Environmental Medicine, 1978, 49, 415-418.

Seventeen male and 20 female college students, permanent N. Mexico residents, non-smokers, ages 18-24 years were tested on a bicycle ergometer in a hypobaric chamber. Females demonstrated smaller relative increases in ventilation than men at submaximal and maximal work levels at acute altitude exposure.

Flint, M. M., Drinkwater, B. L. & Horvath, S. M. Effects of training on women's response to submaximal exercise. Medicine and Science in Sports, 1974, 6(2), 89-94.

Seven female volunteers, ages 23-49 years, were given six weeks of physical training on treadmill walking and were compared with males from other studies. No striking differences in physiological responses to training were noted.

Fox, R. H. & Lofstedt, B. A comparison of thermoregulatory function in men and women. Journal of Physiology, 1968, 197, 44P-45P. Proceedings of the Physiological Society 22-23 March 1968.

Twenty-one Swedish males (avg. age 27 years) and 21 Swedish females (avg. age 22 years) were examined under conditions of rest in a neutral climate, during one hour of slow warming and during one hour of controlled hypothermia. Male sweat rate was significantly greater than that of females and began at a significantly lower deep body and skin temperature. Hypothermia produced a significant decline in male sweat rate and a non-significant decline in female sweat rate.

Gentry, W. D. Sex differences in the effects of frustration and attack on emotion and vascular processes. Psychological Reports, 1970, 27, 383-390.

Thirty male and 30 female college psychology student volunteers had their blood pressure monitored while completing an "intelligence" test under control, "frustration" or "attack" conditions. Male systolic blood pressure rose significantly more than females but there were no differences in the rises of diastolic pressure.

Gisolfi, C. V. & Cohen, J. S. Relationships among training, heat acclimation, and heat tolerance in men and women: The controversy revisited. Medicine and Science in Sports, 1979, 11(1), 56-59.

Six college males and 6 college females performed similar but not same treadmill walks under similar but not same temperature conditions before and after training following heat acclimatization. Authors conclude that 50% improvement in heat tolerance can be derived from 8-11 weeks training under temperate conditions, the improvements being comparable for both sexes and are independent of aerobic capacity.

Howley, E. T. & Glover, M. E. The caloric costs of running and walking one mile for men and women. Medicine and Science in Sports, 1974, 6(4), 235-237.

Eight male and 7 female college physical education majors were tested while walking 1610 meters and running "at a comfortable speed" 1610 meters on a treadmill. Females used slightly (but statistically significantly) more calories than males for both walking and running.

Kowal, D. M., Patton, J. F. & Vogel, J. A. Psychological states and aerobic fitness of male and female recruits before and after basic training. Aviation, Space and Environmental Medicine, 1978, 49, 603-606.

Two hundred male and 200 female Army recruits, ages 17-22 years, were compared on psychological state and physical fitness before and after basic training. Significant improvements were found for males but not females. Males had significantly less body fat after basic training while females had slightly more body fat and greater body weight.

Liberson, C.W. & Liberson, W. T. Sex differences in autonomic responses to electric shock. Psychophysiology, 1975, 12(2), 182-186.

Eighteen male and 18 female volunteers, ages 23-55 were administered one minute of continuous electric shock to a finger at maximum tolerable level. No significant sex differences in heart rate or diastolic blood pressure were noted. Males' systolic blood pressure rose, females' remained constant. Males' respiration dropped and females' rose. Both differences were statistically significant.

McClure, G. & Forgays, D. G. Human sex differences in extreme isolation. Perceptual and Motor Skills, 1975, 40, 387-391.

Fourteen male and 10 female university students, ages 20-31 years were suspended essentially weightless in 94° F. water with auditory stimulation minimized and visual eliminated for up to 12 hrs. (3-4 hrs. avg.). No significant sex differences in heart rates were found.

Morimoto, T., Slabochova, Z., Naman, R. K. & Sargent, F., II. Sex differences in physiological reactions to thermal stress. Journal of Applied Physiology, 1967, 22, 526-532.

Thirteen males (17-32 years) and 13 females (18-23 years) exposed for five 2 hr. periods to increasing heat and either low or high humidity. Male sweat rate was significantly higher than females' for both conditions, greater at higher temperatures. Females displayed a slight rise in systolic blood pressure while males showed a much greater decrease in diastolic blood pressure.

Noble, B. J. Validity of perceptions during recovery from maximal exercise in men and women. Perceptual and Motor Skills, 1979, 49, 891-897.

Eleven male and 10 female college volunteers exercised to exhaustion on a treadmill. No sex differences in heart rate recovery or subjective recovery perceptions were found.

Sloan, A. W. Physical fitness and body build of young men and women. Ergonomics, 1969, 12(1), 25-32.

Fifty male and 50 female Caucasian South African healing sciences students and 44 male and 43 female American medical, dental, physiotherapy students were compared on fitness and a variety of anthropometric measures. Americans were significantly less fit than the South Africans. No significant correlations between fitness and anthropometric measures were found for females but there were significant negative correlations between fitness and body weight and height for American males.

Smith, D. P., Byrd, R. J. & Purcell, W. K. The effect of physical training on cardiac output and physical work capacity in young women. American Corrective Therapy Journal, 1976, 30(4), 115-119.

Twenty-eight physically untrained female volunteers (20-30 years) were given a 9-week training program on a bicycle ergonometer. Significant improvements were made in steady heart rate and work capacity and non-significant cardiopulmonary improvements. Changes were stated to be similar for previously untrained males and females.

Vogel, J. A., Ramos, M. U. & Patton, J. F. Comparisons of aerobic power and muscle strength between men and women entering the U.S. Army. Medical Science in Sports, 1977, 9, 58. (Abstract)

One hundred eighty six male (average ages 21 years) and 159 female (average age 20 years) Army recruits were tested for aerobic power and physical strength during first and sixth weeks of basic training. Physical training did not reduce the large pre-existing differences in aerobic and muscle strength fitness between males and females.

Weinman, K. P., Slabochova, S., Bernauer, E. M., Morimoto, T. & Sargent, F., II. Reactions of men and women to repeated exposure to humid heat. Journal of Applied Physiology, 1967, 22(3), 533-538.

Five males (19-25 years) and 5 females (22-33 years) walked a treadmill in a hot, moist environment for 4 hours on alternate days for 8 sessions. Neither sex showed any significant acclimatization as indicated by diastolic or systolic blood pressures, pulse rate, skin temperature or total heat production.

Wells, C. L. & Horvath, S. M. Metabolic and thermoregulatory responses of women to exercise in two thermal environments. Medicine and Science in Sports, 1975, 6(1), 8-13.

Seven untrained, unacclimatized females walked a treadmill for 40 minutes, and recovered, under both neutral and hot-dry conditions. Extremely high heart rates and reports of discomfort and distress indicated higher physiological strain on females than males.

Wyndham, C. H., Morrison, J. F. & Williams, C. G. Heat reactions of male and female Caucasians. Journal of Applied Physiology, 1965, 20, 357-364.

Thirty males and 26 females were tested at work under 90° F. wet-bulb, 93° F. dry-bulb temperatures. Initial reactions by females were more severe than by males but circulatory reactions were closely similar for both sexes once acclimatized.

FITNESS SUMMARY

General Fitness

1. No sex differences in physiological response to six weeks of treadmill training.

2. No sex differences in work capacity improvement from nine week bicycle ergometer training.

3. Both sexes can profit comparably from eight weeks of heat tolerance training.

4. Army basic training produced fitness improvements in males but not females.

5. Army basic training did not reduce male-female differences in strength or general fitness.

6. No significant correlation between fitness and anthropometric measurements of females but a significant negative correlation between fitness and height and weight of males.

7. Females use slightly but statistically significantly more calories than males walking or running.

8. Males sweat more and start sweating at lower skin temperatures and deep body temperatures than females.

9. Female cadets at USAF Academy are well above civilian contemporaries in physical fitness.

10. Top female athletes are gradually approaching male performance levels in certain competitive sports.

Aerobic

1. Aerobic power peaks at 18 to 20 years of age for both sexes.

2. Aerobic capacity decreases more and faster for males than females.

3. Aerobic fitness measures favor males; females average 70-75% of males' aerobic power (-2SD).

4. Neither Army basic training nor six weeks treadmill training reduced male-female differences in aerobic fitness.

5. No male-female differences in pulmonary ventilation during rest or performance of minimal effort manual task.

6. Females increased pulmonary ventilation less than males while performing maximal and submaximal work at high altitudes.

Heart Rate

1. Females demonstrate non-significantly to significantly higher heart rates than males while performing work under neutral, warm-dry, warm-humid, hot dry conditions.

2. No significant differences in heart rate once acclimatized to work in hot dry environment.

3. No significant acclimatization of either sex to work in hot moist environment.

4. No male-female differences in heart rate recovery after exercise to exhaustion.

5. No male-female differences in heart rate response to sensory deprivation.

6. Females demonstrated improvements from 9-week bicycle ergometer training similar to those for males.

7. Male-female physiological reactions to 6-week treadmill training similar.

Blood Pressure

1. Male systolic blood pressure rose more than females' under psychological stress; no male-female differences in diastolic blood pressure.

2. Male systolic blood pressure rose, females' remained the same during electric shock.

3. Male diastolic blood pressure dropped significantly, female systolic blood pressure rose slightly with increasing environmental heat.

4. Phsyiological improvements from 6-week treadmill training and 9-week bicycle ergometer training similar for both sexes.

5. Neither sex showed significant systolic or diastolic blood pressure acclimatization to hot moist environment.

STRENGTH

Asmussen, E. & Heeboll-Nielson, K. Isometric muscle strength in relation to age in men and women. Ergonomics, 1962, 2, 167-169.

Three-hundred-sixty each, men and women, aged 15 to 60 years were tested for maximal aerobic capacity and isometric muscle strength. Male arm and leg strength increases to age 30 years then it decreases at an accelerating rate. At age 60 it is 90% that at age 20-22 years. Females attain maximum strength at about age 20 when it is about 65% that of 20 year males. Female strength remains about constant from age 20 to 40 when it begins to decrease increasingly until age 55 and reaches a level about 54% that of 55 year old males.

Ayoub, M. M., Bethea, N. J., Deivanayagam, S., Asfour, S. S., Bakken, G. M., Liles, D., Mital, A. & Sherif, M. Determination and modeling of lifting capacity, Final Report, HEW Grant Nos. 1R010H-00545-01 and 5R010H-00545-02, September 1978.

Seventy-three male and 73 female industrial workers were used to determine the maximum "acceptable" weights they could lift to 6 different heights at 4 frequencies in 3 box sizes. Lifting capacity of males was significantly greater than females on all measures.

Bowie, W. & Cumming, G. R. Sustained handgrip in boys and girls: Variation and correlation with performance and motivation to train. Research Quarterly, 1972, 43, 131-141.

Forty-three male and 32 female (ages 13-17 years) attendees at a track and field summer training camp were tested for sustained handgrip at 40% maximum grip strength. Maximum female grip strength was about 74% that of males but females sustained grip times were longer than males'.

Brown, J. R. The contributory factors to the development of low back pain in industry. Presented to the American Industrial Hygiene Conference, Miami, FL, May 1974.

Results of 509 returned (out of 1000) questionnaires showed that:

46% females vs. 35% males had had back injuries
80% females vs. 58% males took sick leave for back troubles
Men had 2 1/3 times the non-back injury accident rate of women
20% males and 7% women lifted weights of 50 lbs.
36% females judged load should not exceed 50 lbs.
51% males judged loads of up to 50 lbs. not unreasonable

Capps, T. E. Physical capacity of females to perform heavy craft skills in the United States Air Force. Report No. 0350-77, Maxwell AFB, TX, Air Command and Staff College, May 1977.

No numerical data or statistical comparisons but, after description of strength-demanding USAF tasks, concludes that personnel must be screened for requirements of jobs, strength requirements of jobs must be established, and jobs, tools and equipment must be designed, where possible, for accomplishment or use by women as well as men.

Chaffin, D. B. Human strength capability and low-back pain. Journal of Occupational Medicine, 1974, 16, 248-254.

A longitudinal study of 500 workers on 103 jobs with varying manual lifting requirements revealed that women demonstrated a mean strength about 58% that of men. The female modal value was 26 lbs., 65% that of the men's 40 lb. modal value.

Dyer, K. F. The trend of the male-female performance differential in athletics, swimming and cycling 1948-76. Journal of Biosocial Science, 1977, 9, 325-338.

Top male and female performances in track, swimming and time trial cycling from 1948 to 1976 were studied. Women's performances were found to be improving relative to men's, leading to the expectation that average female performance will equal that of males during the next century on all events in which both sexes now compete.

Heyward, V. & McCreary, L. Comparison of the relative endurance and critical occluding tension levels of men and women. Research Quarterly, 1978, 49, 301-307.

Eighteen male and 18 female college physical education majors had their endurance tested at three submaximal grip strength levels with circulation artificially occluded by a pressure cuff. The critical occluding tension level was higher in women than men, the endurance performance of women was superior to men's only at the 45% maximum level. Women's grip strength averaged about 36% less than men's.

Jorgenson, K. & Poulsen, E. Physiological problems in repetitive lifting with special reference to tolerance limits to the maximum lifting frequency. Ergonomics, 1974, 17(1), (Jan.), 31-39.

Four males and 4 females ages 21-33 years lifted variable weight box from floor to upright standing position, arms extended to place box on variable height table. Repetitive submaximal lifting capacity limited by oxygen transporting system and muscle strength of back. Maximum lifting frequency for females was about 70% that of males at same relative burden (wgt/body wgt).

Kaplan, M. C. & Knutson, S. J. Human factors analysis of women working in industrial environments. Proceedings of the Human Factors Society--22nd Annual Meeting--1978, pp 243-245.

Analysis of Wisconsin industrial accidents 1975-76 showed women had higher percentages than males of wrist and arm injuries, tendonitis, ganglion injuries, rub and abrasion from repeated motions injuries, skin diseases, and trauma from repeated motions (hammering, pounding).

Karim, B., Bergey, K. H., Chandler, R. F., Hasbrook, A. H., Purswell, J. L. & Snow, C. C. A preliminary study of maximal control force capability of female pilots. FAA-AM-72-27. Department of Transportation, Federal Aviation Agency. Office of Aviation Medicine. Washington, DC 20591.

Twenty-five female pilots were tested in a wooden "cockpit" equipped with strain gauges. Maximal strength data were normally distributed. Maximal allowable force levels too high for a portion of the female population.

Laubach, L. L. Comparative muscular strength of men and women: A review of the literature. Aviation, Space and Environmental Medicine, 1976, 5, 534-542.

Composite of nine strength reports showed:

Upper extremity strength of women 55.8% that of men
Lower extremity strength of women 71.9% that of men
Trunk extremity strength of women 63.8% that of men
Women's dynamic strength averaged 68.6% that of men

Magora, A. Investigation of the relation between low back pain and occupation. Industrial Medicine and Surgery, 1970, 39(11), 465-471.

Three-thousand-three-hundred-sixteen workers in 8 basic occupations were interviewed concerning low back pain. Only 12.9% (429 of the 3316) reported LBP. Of the 429, 73% were male, 27% female. Incidence of LBP was highest in heavy industry (19.1% of males and 35% of females) and nursing (16.7% of males and 16.9% of females). In light industry, 18.0% of males but only 5.2% of females reported LBP.

McDaniel, J. W. A Strength Screening Program for USAF Pilot Candidates. Aerospace Medical Research Laboratory, Wright-Patterson Air Force Base, OH. In Minutes of the Tenth Training and Personnel Technology Conference (TPTC) held 16 February 1978.

Compared with those of males, females were reported to have 63.5% (range 35-86%) total "overall" body strength, 59.4% (range 47-79%) static upper extremity strength, 63.8% (range 37-70%) trunk strength, and 68.6% (range 59-84%) average dynamic strength (lifting, lowering, pushing, pulling). Existing aircraft control force limits often exceed these female average strength capabilities.

Mohr, E. S., Rowan, G. P. & Reidy, R. F. Women and ROTC summer camp 1975. Technical Paper 293. Army Research Institute, for the Behavioral Sciences, September, 1978.

Of 392 male and 83 female ROTC summer camp cadets, females scored lower than males on three physically demanding exercises.

Paragallo, F. R., Jr., Dousa, W. J. Jr. & Lince, D. L. U.S. Army Human Engineering Laboratory Female Artillery Study. USAHEL Technical Memorandum 18-79, October 1979.

Thirteen volunteer female soldiers from administrative jobs were given 3 weeks of intensive physical conditioning and training on 2 howitzers. Females satisfactorily met published rates of fire for both weapons. Only problem arose when women of different heights tried to raise lifting tray into breech recess.

Rich, G. Q., III. Muscular fatigue curves of boys and girls. Research Quarterly, 1960, 31, 485-498.

Fatigue curves for dynamic work of forearm muscles were obtained for 100 males and 100 females aged 8-17 years. Older children were stronger and fatigued faster. When strength loss and steady state levels were compared in relation to initial strength there were no age differences and no or small differences in fatigability

Rogers, S. P. The effects of operator sex and stature on driving performance in the Greyhound MC-7 bus: An experiment (Technical Report 1775). Goleta, CA: Human Factors Research, Inc., August 1976.

Twenty male trainees (aged 24-34) and 60 female trainees (aged 24-34) were given four 4hr training sessions on driving a Greyhound bus then given a 4hr test involving nine maneuvers. Performance differences were hypothesized as being due to differences in strength, motor skill development and responses to the testing situation all of which favored men.

Singh, M. & Karpovich, P. V. Strength of forearm flexors and extensors in men and women. Journal of Applied Physiology, 1968, 25, 177-180.

The strength of elbow flexors and extensors of both arms of 12 male and 11 female college students was measured by an electric dynamometer. Women's strength was found to be between 42% and 47% that of men's.

Snook, S. H. & Ciriello, V. M. Maximum weights and workloads acceptable to female workers. Journal of Occupational Medicine, 1974, 16(8), 524-534.

Sixteen housewives and fifteen female industrial workers were tested on 18 strength tasks and their performances compared with identical measurements on male industrial workers. Industrial women handled significantly more weight than housewives ($p < .01$) but less than industrial men ($p < .05$) on all but three tasks on which they handled not sig. less. Maximum acceptable workloads were less for industrial women than men, for 11 tasks significantly so ($p < .05$). Industrial women selected 85% average weight of industrial men on fast work and 70% on slow work.

Vogel, J. A., Ramos, M. U. & Patton, J. F. Comparisons of aerobic power and muscle strength between men and women entering the U.S. Army. Medical Science in Sports, 1977, 9, 58. (Abstract)

Aerobic power and strength of 186 male (average age 21) and 159 female (average age 20) Army recruits was measured during 1st and 6th week of basic training. Females showed no improvement in muscle strength and men showed improvement only in elbow extension. Physical conditioning did not reduce initial male-female fitness differences.

Williams, M. & Stutzman, L. Strength variation through the range of joint motion. The Physical Therapy Review, 1969, 39(3), 145-152.

The strength of 10 adult males, 10 adult females, 10 male children and 10 female children were measured in 30^{o} intervals throughout range of joint motion by means of tensiometer. Boys were stronger than girls (but not stat. sig.). Greatest strength differences occur at the strongest part of joint range and converge toward point muscles are shortest. Adult male-female differences greater than woman-children.

Wilmore, J. H. Alterations in strength, body composition, and anthropometric measurements consequent to a 10-week weight training program. Medicine and Science in Sports, 1974, 6, 133-138.

Twenty-six college males and 47 females (mean age 20.3) completed 10 week program of intensive weight training. Both males and females made similar relative gains in strength and absolute gains in body composition. Males were stronger than females for all measures although women showed greater leg strength relative to lean body weight.

STRENGTH SUMMARY

1. Males consistently demonstrate greater strength than females.

2. Female strength varies from about 35% to 85% that of males, depending on the "strength" measurement employed.

3. Females are more susceptible than males to lower back pain and back injury as well as wrist and arm injury, tendonitis, ganglion injury and trauma from repeated motions such as hammering.

4. Standard Army basic training produced no improvement in female strength and improvement only in male elbow extension strength.

5. Weight training can increase the strength of both females and males.

COORDINATION

Bachman, J. C. Motor learning and performance as related to age and sex in two measures of balance coordination. Research Quarterly, 1961, 32, 123-137.

One-hundred-sixty males and 160 females 6-26 years old tested before and after ten practice trials on stabilometer and free standing ladder. Females started stabilometer at same levels as males but did significantly ($p < .05$) 12.7% better than males at end. Females started ladder 22% below males and ended 14% lower (sig. $p < .05$).

Barnsley, R. H. & Rabinovitch, M. S. Handedness: Proficiency versus stated preference. Perceptual and Motor Skills, 1970, 30, 343-362.

Fifty males (17-34 years), "mostly" undergraduate psychology students, and 50 females (18-27 years), Children's Hospital employees, administered 32 dexterity, speed, coordination, movement tests. Nine interpretable factors emerged from factor analysis of results. Each factor was common to both male and female performance. "No qualitative sex difference was found." Female performance was relatively better on tasks demanding finely controlled, accurate movements. Males were relatively superior on tasks involving quick, gross movements.

Bird, A. M. Cross sex effects of subject and audience during motor performance. Research Quarterly of the American Association of Health and Physical Education, 1975, 46, 379-384.

Twenty-four males and 24 females, not otherwise described, performed a hand steadiness task and a manual dexterity task before either like or opposite sex audience. No interactive effects were found between sex of subject and sex of audience. Female hand steadiness performance was significant ($p < .05$) superior to that of males. No significant sex differences on manual dexterity.

Carron, A. V. & Bracegirdle, A. A motor learning task involving two-arm balance-coordination. Perceptual and Motor Skills, 1974, 38, 183-187.

Fifteen male and 15 female undergraduate and graduate students performed a maze requiring two-arm balance and coordination. Males performed significantly ($p < .001$) better than females on time to traverse target route.

Cook, T. W. & Shephard, A. H. Performance on several control-display relationships as a function of age and sex. Perceptual and Motor Skills, 1958, 8, 339-345.

Performances of females (no numbers given) in age group 5, 10 and 20 yrs. on. Toronto Complex Coordinator tasks were compared with separately obtained performances of males. Males did significantly ($p < .01$) better than females.

Darden, E. & Shappell, R. T. Performance by males and females on three motor tasks under standard and mirror reversal conditions. Research Quarterly, 1972, 43, 460-467.

Nine college age males and 9 females performed star tracing, tapping and rotary pursuit tasks under standard conditions and while looking at reversal-effect mirror. No significant differences were found.

Eberhardt, N. K. The effect of sleep loss on the rate of gain of information in choice reactions (Interim Technical Report No. 1TR-79-21). Performance Assessment Laboratory, Department of Psychology, Old Dominion University. Norfolk, VA, July 1979 (Contract AFOSR-78-3512).

Twelve volunteer college males and 12 females, 18-30 years, median 19, performed choice reaction time response tasks under normal (control) conditions or periodically during 36 hrs without sleep. Females were initially significantly faster than males in both verbal and motor (fine coordination, discrete dexterity) responses. Sleep-loss females did significantly poorer than control females. There were no significant differences between sleep-loss and control males. (Speculates "macho" effect due to all female experimenters.)

Horn, P. W. Individual consistencies in reminiscence on two motor tasks. Journal of General Psychology, 1976, 94, 271-274.

Thirty male college psychology students and 30 females performed pursuit rotor and inverted alphabet printing tasks under conditions of massed practice (8 30-sec trials) or rest (30 min rest between trials 6 & 7). Males performed significantly ($p < .05$) better than females on pursuit rotor task. Females performed significantly ($p < .05$) better than males on inverted alphabet printing. Both sexes showed significant improvement on both tasks for rest over no-rest with males' improvement on pursuit rotor significantly ($p < .05$) greater than females'.

Huang, K. L. & Payne, R. B. Individual and sex differences in reminiscence. Memory and Cognition, 1975, 3, 252-256.

Forty-two male and 42 female college psychology students, (modal age 18) performed inverted alphabet printing, rotary pursuit, and mirror tracking tasks on a 3 minute schedule: Practice-rest-practice-rest-practice-transit to next task. Females performed significantly ($p < .01$) better than males on the alphabet printing with both sexes improving equally last against first test. Males performed significantly ($p < .01$) better than females on rotary pursuit and increased superiority over trials. Males and females were equal on mirror tracking at start of trials but males were significantly superior at end.

Karlins, M. & Lamm, H. Sex differences and motor task performance. Perceptual and Motor Skills, 1965, 20, 430.

Fifty male and 50 female college students filled circles with X's as rapidly as possible for fifty minutes. No significant sex differences were found either for the first 5 minutes or for the total period.

Kipnis, D. M. & Kidder, L. H. Practice, performance, and sex: Sex-role appropriateness, success, and failure as determinants of men's and women's task learning capability (Technical Report No. 1), May 1977. Temple University, Contract No. N0014-75-C-Q1618; NR 170-796. (University City Science Center, Philadelphia, PA).

Forty three male and 42 female college psychology students trained on pursuit rotor task under a variety of experimental conditions and on marble labyrinth, then tested. Males performed significantly better (time on target) than females on pursuit rotor regardless of treatment and better (holes passed) on labyrinth.

McCaffrey, R. J. & Payne, R. B. Interaction of sex and practice distribution effects. Bulletin of the Psychonomic Society, 1977, 10, 382-384.

Twenty four male and 24 female college students performed tracking task with mirror vision under massed and distributed learning conditions. No sex differences were found.

Morrison, M. W., Gregory, R. J. & Paul, J. J. Reliability of the Finger Tapping Test and a note on sex differences. Perceptual and Motor Skills, 1979, 48, 139-142.

Sixty male and 60 female college psychology students (modal age 19) performed Finger Tapping Test, either test-retest with one examiner or test by each of two examiners. Males were significantly ($p < .05$; $p < .001$) faster than females.

Nelson, J. K. & Johnson, B. L. Effects of local and general fatigue on static balance. Perceptual and Motor Skills, 1973, 37, 615-618.

Sixty college males and 60 females tested on "stork" balance on ball of preferred foot before and after either "local" exercise (heel rise on preferred foot) or "general" exercise (squat-thrust) at rate of 1/sec. No significant sex difference in performance impairment. Both kinds of exercise affected static balance, "general" significantly more than "local".

Newell, K. M. & Wade, M. G. Stabilometer trial length as a function of performance. Research Quarterly, 1974, 45, 16-20.

Twelve male and 12 female college undergraduates were given 60 trials on stabilometer. No significant sex differences were found.

Noble, C. E. Acquisition of pursuit tracking skill under extended training as a joint function of sex and initial ability. Journal of Experimental Psychology, 1970, 86, 360-373.

Two hundred fifty six male and 244 female white college students (17-41 years) trained on USAF Rotary Pursuit apparatus for one hundred 20-sec trials. Males were significantly more accurate and less variable than females in their performances.

Noble, C. E. & Noble, C. S. Pursuit tracking skill with separate and combined visual and auditory feedback. Journal of Motor Behavior, 1972, 4, 195-205.

Eighteen male and 18 female undergraduates (17-24 years) performed modified USAF Rotary Pursuit task under visual, auditory or auditory plus visual feedback conditions. Males were significantly ($p < .01$) superior to females under visual and auditory plus visual conditions but equally poor under auditory only. Replication with 24 male and 24 female undergrads (18-26 years) gave same results ($p < .01$).

Parker, D. M. Effects of seasickness on error scores in mirror tracing. Journal of General Psychology, 1969, 81, 147-151.

Thirty-five male and 38 female college undergraduate volunteers performed five-point star tracing task with mirror vision under dry land, on deck at sea and below deck at sea conditions. No significant male-female differences in performance due to seasickness but "while the male makes fewer errors per second when not sick than does the female, he makes significantly ($p < .01$) more errors than the female when he is sick."

Payne, R. B. & Huang, K. L. Interaction of sex and task differences in reminiscence. Journal of Motor Behavior, 1977, 9, 29-32.

Forty-two male and 42 female college psychology students were tested on inverted alphabet printing, USAF Rotary Pursuit Test, and mirror vision tracking task under three task order sequences. Males performed significantly ($p < .001$) better than females on both rotary pursuit and mirror tracking. Females improved significantly more than males on rotary pursuit ($p < .05$) and mirror tracking ($p < .01$). No significant differences on alphabet printing.

Rogers, S. P. The effects of operator sex and stature on driving performance in the Greyhound MC-7 bus: An experiment (Technical Report 1775). Goleta, CA: Human Factors Research, Inc., August 1976.

Twenty male trainees (24-34 years) and 60 female trainees (24-34 years) were given 16 hours training in driving Greyhound bus then tested (approx. 4 hrs) on nine problems. Males scored (time and errors) better than females on parallel parking and significantly better on all other problems. Male scores were generally less variable than females'.

Smith, T. L. The effect of coactors upon the motor performance of male and female subjects of different ages (Doctoral dissertation, Louisiana State University, May 1972). (University Microfilms International) 1977.

Twenty-four males and 24 females in each of three age groups (8, 13, 18) performed dart throw for accuracy and speed-and-accuracy under three conditions. Males performed better than females on both the accuracy task and the speed and accuracy task (with the difference increasing with age).

Thomas, J. R., Cotten, D. J., Spieth, W. R. & Abrahm, N. L. Effects of fatigue on stabilometer performance and learning of males and females. Medicine and Science in Sports, 1975, 7(3), 203-206.

Thirty male and 30 female undergraduate volunteers were tested for dynamic balance on stabilometer before and after fatigue induced by walking a treadmill. Fatigue has a significant effect on balance but there were no significant male-female performance differences in either control or experimental groups.

Williges, B. H. & Williges, R. C. Learner-centered versus automatic adaptive motor skill training. Journal of Motor Behavior, 1977, 9(4), 325-331.

Eighteen male and 18 female college undergrads, non-pilots engaged in a two-dimensional tracking task under experimental training conditions and transfer of training task. Females took significantly ($p < .001$) longer time to reach criteria performance than males but no sex differences in transfer of training from experimental to transfer task, i.e., both sex performed equally well on transfer task.

COORDINATION SUMMARY

Type	Number of Citations Reporting		
	Male Superiority	No Differences	Female Superiority
Rotary Pursuit - standard	7	1	
Rotary Pursuit - mirror		1	
Tracing/Tracking - standard		2[1]	
Tracing/Tracking - mirror	2	3	
Inverted Alphabet Printing		1	2
Fine Manual Dexterity		1	1
Fine Motor Coordination			1
Gross Motor Coordination	1		
Whole Body Balance		3	1
Hand Steadiness			1
Two Arm/Hand Coordination	2		
Complex Coordination	1		
Dart Throw	1		
Tapping	1	1	

[1]Females took longer to reach criteria but no sex differences on transfer-of-training task in one experiment.

Boggs, D. H., & Simon, J. R. Differential effect of noise on tasks of varying complexity. Journal of Applied Psychology, 1968, 52, 148-153.

Twenty-four male and 24 female college psychology students performed simple or complex 4-choice reaction time Primary Task (one of four lights corresponded to one of four switches; no correspondence of lights to switches) simultaneously with Secondary Task (oral response to auditory stimulus) under conditions of noise and quiet. Males were non-significantly faster than females on Primary Task. No significant differences on Secondary Task.

Botwinick, J., & Thompson, L. W. Components of reaction time in relation to age and sex. Journal of Genetic Psychology, 1966, 108, 175-183.

Twenty-nine males (19-32 years) and 15 females (18-35 years) (also 17 males, 68-87 years, and 27 females, 69-84 years) given warning tone, pressed telegraph key at onset of stimulus tone and as long as it lasted, then released key. No significant male-female differences were found.

Coles, M. G. H., Porges, S. W., & Duncan-Johnson, C. C. Sex differences in performance and associated cardiac activity during a reaction time task. Physiological Psychology, 1975, 3(2), 141-143.

Ten male and 10 female (18-21 years) college students were shown a red light and were to close microswitch with dominant hand as soon as possible after extinguishing of light. Males showed significantly ($p<.01$) faster reaction times than females. Males has a slower heart rate and showed greater heart rate variability than females but the difference was not significant.

Coules, J., & Avery, D. L. Human performance and basal skin conductance in a vigilance-type task with and without knowledge of results. Perceptual and Motor Skills, 1966, 23, 1295-1302.

Five male and five female college student lab assistants plus two male lab staff members (20-36 years) pressed telegraph key in response to appearance of stimulus on CRT with and without knowledge of reaction time results presented on CRT. No sex differences.

Eberhardt, N. K. The effect of sleep loss on the rate of gain of information in choice reactions (Interim Technical Report No. ITR-79-21). Norfolk, VA: Performance Assessment Laboratory, Department of Psychology, Old Dominion University, July 1979 (Contract AFOSR-78-3512).

Twelve male and 12 female college student volunteers (18-30 years) performed 2-, 3-, 4-, 6-, or 8-choice reaction time tasks verbally or by motor response under sleep loss and no sleep loss conditions. Females were significantly faster than males, initially, in both verbal and motor modes. Sleep-loss females did significantly poorer than control females. There were no significant differences between experimental and control males. Speculate "macho" effect with only female data collectors.

Henry, F. M. Stimulus complexity, movement complexity, age, and sex in relation to reaction latency and speed in limb movements. Research Quarterly, 1961, 32, 353-366.

Both sexes and an age range 8-30 years were encompassed by 402 subjects. Procedure involved a warning signal followed in 1-4 seconds by a stimulus for a movement task. Reaction latency and time required to perform basic limb movement were measured. No significant sex differences were found for reaction time but females were significantly slower than males in speed of movement.

Hodgkins, J. Reaction time and speed of movement in males and females of various ages. Research Quarterly, 1963, 34, 335-343.

Both sexes and an age range 6-84 years were encompassed by 930 subjects. Reaction time to a flashed light and the time to complete a hand and arm movement were measured. Males 12-54 showed significantly ($p<.01$) faster reaction times than females (no differences for younger and older age groups) and significantly ($p<.01$; $p<.05$) greater speed of movement than females for all age groups.

Hoffman, D. T. Sex differences in preferred finger tapping rates. Perceptual and Motor Skills, 1969, 29, 676.

One-hundred-nineteen males and 201 females, not otherwise identified, were told to tap a telegraph key "in whatever manner feels most comfortable" during the duration (10 seconds) of a signal light. Frequency of key taps recorded mechanically. Males were significantly ($p<.01$) faster than females.

Kallman, W. M., & Isaac, W. Altering arousal in humans by varying ambient sensory conditions. Perceptual and Motor Skills, 1977, 44, 19-22.

Six male and 6 female college student volunteers pressed button with right hand when left hand tactily stimulated under combinations of light, dark, quiet and noise. Replicated after 3-8 weeks. No statistical differences reported but, "In general, the males were faster than the females and showed greater improvement in performance across replications . . . ."

Nagler, C. A., & Nagler, W. M. Reaction time measurements. Forensic Science, 1973, 2, 261-274.

One-hundred-forty-two males and 73 females, ages 10-60 years, had reaction time tested under simulated vehicle driving conditions. Mean reaction times for single and married males and females were virtually identical, i.e., 0.61 to 0.63 seconds.

Noble, C. E., Baker, B. L., & Jones, T. A. Age and sex parameters in psychomotor learning. Perceptual and Motor Skills, 1964, 19, 935-945.

Thirty experimental groups consisting of 20 males and 20 females of same age range, total range 8-87 years, subject total 600. Tested in groups of two or four on USAF Discrimination Reaction Time apparatus with six familiarization trials followed by 320 training trials. Females showed a rapid improvement in reaction time to age 16, then a gradual decline. Males showed a similar improvement to age 20, then gradually declined. Males consistently performed significantly faster than females.

Noble, C. E., & Hayes, J. R. Discrimination reaction performance as a function of anxiety and sex parameters. Perceptual and Motor Skills, 1966, 23, 1267-1278.

Fifty each high and low anxiety male and high and low anxiety female college psychology students (selected on basis of Taylor's Biographical Inventory) were given 320 trials on the USAF Discrimination Reaction Timer with non-specific instructions. Males were significantly ($p<.001$) faster than females. Low anxiety males were consistently superior to high anxiety males. Low anxiety females were initially superior to high anxiety females, inferior later.

Noble, C. E., & Skelley, C. S. Performance of men and women during extended practice in discrimination reaction. Bulletin of the Psychonomic Society, 1976, 8, 241. (Abstract)

Eighty not otherwise identified college students were given 240 trials daily on the Discrimination Reaction Timer for six days. Males and females had similar speeds on the first two days. Males were significantly faster than females on the last two days as sexes approached different speed asymptotes. Both sexes made similar error scores throughout.

Persinger, M. A., Lafreniere, G. F., & Mainprize, D. N. Human reaction time variability changes from low intensity 3-Hz and 10-Hz electric fields: Interactions with stimulus pattern, sex and field intensity. International Journal of Biometeorology, 1975, 19, 56-64.

Thirty male and 30 female university students (19-29 years) made 80 simple reaction times to the onset of a light stimulus during three sucessive 10-minute exposures to 3 Hz and 10 Hz electric fields at two intensities. No significant differences in mean reaction times were noted although there were a variety of differences in patterns of variabilities as functions of field intensity and frequency change.

Reynolds, R. E., White, R. M., Jr., & Hillgendorf, R. L. Detection and recognition of colored signal lights. Human Factors, 1972, 14, 227-236.

Twenty-four male and 24 female college students in groups of six males and six females were presented four stimulus colored lights against one of four background colors under two illumination levels, pressed switch on response panel to indicate position of stimulus, reported color orally. If incorrect, reaction time continued to correct identification. Experiment replicated with additional 48 males and 48 females to incorporate task difficulty level. No significant male-female performance differences were found.

Simon, J. R. Choice reaction time as a function of auditory S-R correspondence, age and sex. Ergonomics, 1967, 10(6), 659-664.

Sixteen male and 16 female undergraudate students (age 18-25) and 16 males and 16 females (age 65-86) pressed key in response to stimulus tone heard through one or other ear. Ipsilateral: pressed key on same handed side as tone heard. Contralateral: pressed key on opposite side. No male-female reaction times reported but the differences between crossed and uncrossed performances were significantly ($p<.05$) greater for females than males.

Williams, J. M. Effects of evaluative and nonevaluative coactors upon male and female performance of simple and complex motor tasks. Doctoral Dissertation, The Florida State University, 1975. (University Microfilms International, 1977)

Ninety-six male and 99 female college undergraduate students performed a reaction time task consisting of manipulating one of eight objects (e.g., button, foot pedal, knob) in response to a single digit numerical display at either a "simple" or "complex" level of difficulty, either alone or in presence of another "dummy subject." No sex differences were found in performances.

Wright, G. R., & Shephard, R. J. Brake reaction time: Effects of age, sex, and carbon monoxide. Archives of Environmental Health, 1978, 33, 141-150.

Two-hundred-ninety-three male and 59 female Canadian car drivers were given a braking response test and a questionnaire relating to carbon monoxide exposure. Braking response times were significantly ($p<.01$) slower for females than males.

REACTION TIME SUMMARY

Type	Number of Citations Reporting		
	Male Superiority	No Differences	Female Superiority
Simple RT	3	4	--
Choice RT	--	4	1
Discrimination RT	3	--	--
Simulated Vehicle RT	--	1	--
Vehicle Braking RT	1	--	--
Speed of Movement	2	--	--
Telegraph Tap	1	--	--

AUDITION

Bakan, P., & Manley, R. Effect of visual deprivation on auditory vigilance. British Journal of Psychology, 1963, 54, 115-119.

Forty-four male and 44 female college undergraduate students performed an auditory vigilance task consisting of detecting sequences of three digits, odd-even-odd, all different from a continuous series of digits under conditions of normal vision and visual deprivation by blindfold. The blindfold had no significant effect on female performance but significantly ($p<.05$) improved male performance.

Coran, N. L., & Boffa, J. Perceived control, self-observation, and response to aversive stimulation. Journal of Personality and Social Psychology, 1970, 16, 1-4.

Forty college students (no sex identification), ages 18-21, provided self-ratings of experienced discomfort on exposure to aversive white noise. Galvanic skin responses were measured. There were no sex differences in GSR but females rated sounds as producing significantly ($p<.05$) more discomfort than did males.

Corso, J. F. Age and sex differences in pure-tone thresholds: Survey of hearing levels from 18 to 65 years. Archives of Otolaryngology, 1963, 77, 385-405.

Nine-hundred-twelve subjects, approximately half of each sex, ages 18-65, were tested for pure-tone auditory thresholds at nine frequencies from 250 to 8,000 cps. Females' hearing was, on the average, more acute and, except in the 51-65 age range, showed less intersubject variability than males'.

Kumar, P., & Mathur, C. N. Sex and noise distractibility. Indian Journal of Applied Psychology, 1969, 6, 13-14.

Forty male and 40 female undergraduate and post-graduate university students performed a cancellation and mental arithmetic task under normal and noisy conditions. Male performance of both tasks deteriorated in the presence of noise (no significance given). Female performance on mental task deteriorated and on mechanical task improved, although not significantly in either case in presence of noise.

McCann, P. H. The effects of ambient noise on vigilance performance. Human Factors, 1969, 11, 251-256.

Ten male and 10 female hired subjects, ages 20-30 years, compared a list of 7-digit numbers against audio presentation of 7-digit numbers under three conditions of ambient noise. No significant sex differences in performance were found.

McGuinness, D. Hearing: Individual differences in perceiving. Perception, 1972, 1, 465-473.

Twenty-five male and 25 female English college students, ages 18-26 years, were tested for pure-tone threshold, judgment of loudness, pitch discrimination, and subjective annoyance reaction to repeating auditory stimulus. For pure-tone threshold, there were no significant sex differences except that females' hearing was "substantially" more acute in the high frequencies than males' and males had "considerably" less hearing loss than females in the normal range (3,000-6,000 Hz). Females judged sounds to be significantly ($p<.001$) louder than did males. No sex differences were found in pitch discrimination.

McGuinness, D. Equating individual differences for auditory input. Psychophysiology, 1974, 11(2), 113-120.

Twenty-five male and 25 female undergraduate psychology students, ages 18-26 years, were given standard audiometric tests for auditory thresholds at 10 frequencies, 125-12,000 Hz, then allowed to adjust loudness to level "too loud" on subjective scale from "inaudible" to "pain." Thresholds essentially the same for both sexes except females' acuity is greater at 10,000 and 12,000 Hz than males' (significance not given). Males had significantly ($p<.001$) greater loudness tolerance than females across whole frequency range.

Samuel, W. M. S. Noise and the shifting of attention. Quarterly Journal of Experimental Psychology, 1964, 16, 264-267.

Five males and five females (no other identification) added two numbers from same source (no shift) and from two sources (shift) under no noise (80 db) and noise (110 db) conditions. Males did significantly better than females on no-shift task. Females had significantly fewer omissions and significantly lower percentage of errors (but not number of errors) than males under noise.

Simpson, W. E., & Stanton, L. D. Head movement does not facilitate perception of the distance of a source of sound. American Journal of Psychology, 1973, 86, 151-159.

Two experiments reported. Experiment one employed 18 male and 18 female college psychology students to judge distance of source of sound with head fixed or moved. Males made significantly ($p<.05$) larger distance estimates than females--accuracy of estimates not given. Experiment two employed 20 male and 20 female college psychology students and four male and four female advanced psychology students on staff to judge movement of sound source. Males demonstrated significantly ($p<.01$) lower movement threshold than females.

Simpson, W. E., & Vaught, G. M. Visual and auditory autokinesis. Perceptual and Motor Skills, 1973, 36, 1199-1206.

Fifty-seven male and 57 female college psychology students were tested for visual and auditory autokinesis in two experiments employing different instructions and, in second experiment, extraneous stimuli. No sex differences in autokinesis were found in either experiment.

Smith, P. E., Jr. A test for susceptibility to noise-induced hearing loss. American Industrial Hygiene Association Journal, 1969, 30(3), 245-250.

Fifteen male and 15 female volunteers, ages 22-65 years, were exposed to an automatic audiometer as both a noise source and test instrument. Noise induced permanent threshold shifts were found in males exposed to industrial noise but not in comparable females. None of the females fell into the high risk group for permanent hearing loss. Females judged less susceptible than men to ill effects of noisy industrial environment.

Woodford, C., Henderson, D., Hamernik, R., & Feldman, A. Threshold-duration function of the acoustic reflex in man. Audiology, 1975, 14, 53-62.

Five male and five female adults with normal hearing and three male adults with hearing loss of cochlear etiology were subjected to a series of reflex-eliciting stimuli. Males showed a consistently flatter threshold-duration function than females, speculated to be due to history of exposure to noises such as gunshots, motorcycles, etc.

AUDITION SUMMARY

Type	Number of Citations Reporting		
	Male Superiority	No Differences	Female Superiority
Pure-tone Acuity	--	2	1
Pitch Discrimination	--	1	--
Intensity Tolerance	3	--	--
Noise Distraction Tolerance	--	2	2
Movement Detection	1	--	--
Autokinesis	--	2	--

VISION

Adams, J. Visual perception of direction and number in right and left visual fields. Cortex, 1971, 7, 227-235.

Thirty-nine male (mean age 21.4) and 56 female (mean age 19.4) college students were presented visual stimuli on Multiple-Pattern Visual Field Screener and required to select correct responses from multiple-choice response card. No significant differences were found.

Bakan, P., & Manley, R. Effect of visual deprivation on auditory vigilance. British Journal of Psychology, 1963, 54, 115-119.

Forty-four male and 44 female college undergraduate students performed an auditory vigilance task consisting of detecting a sequence of three digits, odd-even-odd all different, in a continuous series of digits under conditions of normal vision and visual deprivation by a blindfold. Visual deprivation had no effect on female performance but significantly ($p<.05$) improved the performance of males.

Barthol, R. P. Individual and sex differences in cortical conductivity. Journal of Personality, 1958, 26, 365-378.

One-hundred-six college students (no sex identification), 18-21 years, were tested for phi-phenomenon and kinesthetic figural aftereffect. No male-female differences were found.

Brownfield, M. K. Sex and stimulus time difference in aftereffect durations. Perceptual and Motor Skills, 1965, 21, 446.

Thirty college students (no sex identification), ages 18-21 years, viewed a light stimulus in a dark room and duration of afterimage was recorded. Males' afterimage lasted longer than females' (no significance reported).

Burg, A., & Hulbert, S. Dynamic visual acuity as related to age, sex, and static acuity. Journal of Applied Psychology, 1961, 45, 111-116.

One-hundred-ten male and 126 female students and university employees ranging in age from 16 to 67 years, with 79% between 16-25 years, were tested on a Dynamic Visual Acuity Tester. Males' performance was consistently better than females' on each test, with performance on the static screen and on three of the six dynamic speeds significantly ($p<.002$) better.

Burg, A. Visual acuity as measured by dynamic and static tests: A comparative evaluation. Journal of Applied Psychology, 1966, 50, 460-466.

Seventeen-thousand-five-hundred volunteer California drivers, ages 16-92 in 5-year groups, had visual acuity tested, static by Orthorater and dynamic by sweeping checkerboard across 180° horizontally curved screen. Visual acuity was poorer for moving than stationary target. Males had slight, consistent but not statistically significant superiority over females on both static and dynamic acuity.

Burg, A. Light sensitivity as related to age and sex. Perceptual and Motor Skills, 1967, 24, 1279-1288.

Seventeen-thousand-five-hundred (62.8% male, 37.2% female) volunteer California drivers, ages 16-92 years, tested with UCLA "Glarimeter." No significant sex differences in threshold illumination (light intensity needed to identify target against glare) or glare recovery.

Cancro, R., & Voth, H. M. Autokinesis and psychological differentiation. Perceptual and Motor Skills, 1969, 28, 99-103.

Twenty-eight male and 77 female volunteers from community, mean age 25.8 years, SD 8.6 years, administered Embedded Figures Test, Rod and Frame Test and an Autokinetic Test consisting of tracing on paper the apparent movement of a pinpoint of light in an otherwise dark room. No significant male-female autokinetic score differences.

Chaplin, J. P. Sex differences in the perception of autokinetic movement. Journal of General Psychology, 1955, 52, 149-155.

Thirty-two male and 27 female undergraduate psychology students (naive) presented stimuli in darkproof box, activated switch when movement noted and recorded direction and extent on pad of paper. Repeated with 20 male and 24 female students giving oral responses only. Males' response time to "detect" significantly ($p<.05$) faster than females'. Males detected significantly ($p<.01$) greater "movement." Females gave 13% more "no movement" reports than males. (From subjects' comments, majority of males believed stimuli actually moved, some refusing to believe stationary even after explanation. Majority of females realized movement was illusory after a few cases.)

Gur, R. E., Gur, R. C. Sex differences in the relations among handedness, sighting-dominance and eye-acuity. Neuropsychologia, 1977, 15, 585-590.

One hundred males and 100 females, General Hospital workers and non-psychiatric patients tested for handedness, on three measures of sighting dominance and one eye acuity. Handedness associated with sight-dominance for males but not females. Eye acuity was associated with sight-dominance for females but not males.

Hannay, H. J., Boyer, C. L. Sex differences in hemispheric asymmetry revisited. Perceptual and Motor Skills, 1978, 47, 315-321.

Fifty-six male and 56 female right-handed undergraduate psychology students were presented 10 trigrams tachistoscopically unilaterally and vertically four times, twice to each, left and right, visual field. No male-female differences in number correct identifications. Right visual field was significantly ($p<.001$) superior to left.

Harley, J. P., Kalish, D. I., & Silverman, A. J. Eye movements and sex differences in field articulation. Perceptual and Motor Skills, 1974, 38, 615-622.

Ten male and 10 female undergraduate psychology students administered a visual disc estimation-matching task, illuminated Rod and Frame Test, Embedded Figures Test and a Handedness questionnaire. Eye movements were electronically recorded. Females scored significantly ($p<.05$) more field dependent than males on RFT. No sex differences were found on size estimation, EFT or number of vertical or horizontal eye movements. Eye movements did not correlate with either RFT or EFT.

Kimura, D. Spatial localization in left and right visual fields. Canadian Journal of Psychology, 1969, 23, 445-458.

Six experiments using, respectively, 38, 46, 28, 34, 20 and 32 college students, ages 18-21 years, were conducted in which stimuli were presented to right and left visual fields. In one experiment males, but not females, were more accurate when a dot was presented in left visual field. In all other experiments no sex differences were found.

Kuechenmeister, C. A., Linton, P. H., Mueller, T. V., & White, H. B. Eye tracking in relation to age, sex, and illness. Archives of General Psychiatry, 1977, 34, 578-579.

Nine groups of 10 patients each, ages 20 years and up, (40 normal, 40 schizophrenic, 10 Parkinson) visually tracked a target as it traversed horizontally ±10° from center. Eye movements measured by differential infrared reflectometric sensor. Males are better eye trackers than females.

Lentz, J. M. Nystagmus, turning sensations, and illusory movement in motion sickness susceptibility. Aviation, Space, and Environmental Medicine, 1976, 47, 931-936.

Forty-eight college students, aged 18-39 years, were administered a motion sickness history questionnaire and nystagmic eye movements and turning sensations elicited by vestibular stimulation. No significant sex differences were found although there was a tendancy for women to have more slow-phase nystagmus.

Noble, B. J. Validity of perceptions during recovery from maximal exercise in men and women. Perceptual and Motor Skills, 1979, 49, 891-897.

Eighteen male and 18 female undergraduate psychology students steadily viewed three triangular forms while exposed to one of three audible tones. Females' visual perception was facilitated by auditory stimulation more than mens'. Females perceived triangles with greater stability than men in five of six comparisons. Females were relatively less influenced by changes in shape of triangles than men.

Pennal, B. E. Human cerebral asymmetry in color discrimination. Neuropsychologia, 1977, 15, 563-568.

Subjects consisted of 43 right-eye dominant and 16 left-eye dominant males and 49 right-eye dominant and 17 left-eye dominant females (no age identification). Color stimuli were presented tachistoscopically to left and right visual fields. Manual color matching response measured for accuracy and latency of response. No differences were found between sexes or left-right eye dominance.

Porac, C., & Coren, S. Is eye dominance a part of generalized laterality? Perceptual and Motor Skills, 1975, 40, 763-769.

Seventy-eight males and 82 females (no other identification) were administered three tests of left-right eye use and a handedness questionnaire. No significant correlation was found between sight dominance measures and handedness for females. Significant correlations between handedness and pointing ($p<.01$) and total score ($p<.05$) for males. Males were significantly ($p<.05$) more consistent in eye preference than females.

Pressey, A. W. Sex differences on tests of visual figural aftereffects. Acta Psychologica, 1970, 34, 78-88.

Three related experiments were reported, the first with 280 male and 280 female Canadian university students, the second with 152 males and 159 females from the first, and third with 80 additional male and 80 female Canadian students. All experiments involved tests of visual figuration aftereffects (FAE) with the first and third using a method of adjustment and the second a method of detection. No significant sex differences were found in experiments one and three. Females reported significantly less FAEs than males in experiment two. The differences appear to be dependent on method used.

Reilly, T. Some normative data for the spiral aftereffect. Perceptual and Motor Skills, 1970, 31, 211-217.

Thirty-five males and 32 females, aged 18 to 31, exposed to arithmetic spiral disc rotated in both directions. Although some evidence of sex differences in the perception of Spiral Aftereffect was found, ". . . the sex differences are not consistently obtained."

Reynolds, L. T. A note on the perpetuation of a "scientific" fiction. Sociometry, 1966, 29, 85-88.

Essay. Author reviews articles and concludes that the claim that women are capable of making finer visual color discriminations than can men is undocumentable.

Reynolds, R. E., White, R. M., Jr., & Hilgendorf, R. L. Detection and recognition of colored signal lights. Human Factors, 1972, 14, 227-236.

Twenty four male and 24 female college students with normal (or corrected) acuity and color vision were used. Six of each sex were presented four stimulus colored lights against one of four colored backgrounds and required to press switch to identify location of stimulus and report color orally (if incorrect, reaction timer continued until correct identification). Experiment replicated with additional 48 males and 48 females and the inclusion of a task difficulty variable. No significant male-female performance differences were found.

Simpson, W. E., & Vaught, G. M. Visual and auditory autokinesis. Perceptual and Motor Skills, 1973, 36, 1199-1206.

Two experiments. Experiment one used 25 male and 25 female college psychology students. Experiment two used 32 male and 32 female college psychology students. Experiments involved visual and auditory autokinesis with different instructions and, in experiment two, the presence of extraneous vibratory sound and tactile stimuli. No sex differences were found in either experiment.

Slonim, P. S., Weissman, S., Glazer, E., & Nettler, P. A. Effects of training on dynamic stereo acuity performance by males and females. Perceptual and Motor Skills, 1975, 40, 359-362.

Thirty male and 30 female college students were tested for dynamic visual acuity using Howard-Dohlman device then assigned to one of three training conditions. Males had significantly ($p<.05$) better dynamic acuity only with no training. Females profit from training as much as males but have significantly ($p<.001$) greater variability than males.

Trembly, D. Clerical speed: The visual dexterity factor in learning. Academic Therapy, Fall 1971, Vol. VII, No. 1, 15-20.

(No data; no experiment) "Boys are . . . still slower than girls [in visual dexterity] when the aptitude becomes fully mature around the age of twenty . . . . with fewer than 25 percent of the males scoring above the female median . . . ."

Veldman, D. J. Correlates of visual acuity in college freshmen. Perceptual and Motor Skills, 1970, 30, 551-558.

Data collected for other purposes from 1,362 male (44% wearing glasses) and 959 female (52% wearing glasses) college freshmen, Fall 1963, were subjected to a variety of statistical analyses. "Male glasses wearers were slighter of build and less ambitious than male non-glasses wearers; the reverse was true among females." Otherwise no sex differences.

Vodde, T. W., & Robertson, M. H. The effect of visual restriction or overstimulation upon number recognition. Journal of General Psychology, 1969, 80, 171-176.

Twenty-four male and 24 female college psychology students were tested with a list of 5-digit numbers presented tachistoscopically before and after exposure to Visual Restriction (blackout), Visual Overstimulation, or Control (normal lighting). No significant sex differences.

White, R. C. Effects of prolonged dark adaptation on autokinetic movement. Perceptual and Motor Skills, 1973, 36, 521-522.

Ten male and 10 female naive college undergraduate students, half given one hour dark adaptation, half given 5 minutes dark adaptation before exposure to autokinetic stimulus. No sex differences for either group in speed of response, direction or distance of "movement."

Williams, J. M., & Thirer, J. Vertical and horizontal peripheral vision in male and female athletes and nonathletes. Research Quarterly, 1975, 46, 200-205.

Fifty-three male and 20 female athletes and 25 male and 25 female nonathletes were tested for maximum field of vision. Athletes were found to have superior vertical and horizontal fields of vision compared with nonathletes. No sex differences in field of vision except that in the vertical range females demonstrated greater high vertical range of vision than males (no significant given).

VISION SUMMARY

Type	Number of Citations Reporting		
	Male Superiority	No Differences	Female Superiority
Static Acuity	1	1	--
Dynamic Acuity	2[α]	1	--
Glare Threshold/Recovery	—	1	--
Autokinesis	--	4	1
After Image	--	4	2
Perception of Color Against Color	—	2	--
Size Estimation	--	1	--
Eye Tracking	1	--	--
R-L Visual Field Performance	--	4	--
Reaction to Restriction/ Overstimulation	--	1	--

[α]Males superior only with no training; training eliminated sex differences.

Botkin, A. L., Schmaltz, L. W. & Lamb, D. H. "Overloading" the left hemisphere in right-handed subjects with verbal and motor tasks. Neuropsychologia, 1977, 15, 591-596.

Fifty-one male and 51 female undergrad psychology students, all right-handed, performed motor tasks with left or right arm while simultaneously reciting digits backwards. Females repeated significantly ($p < .05$) more digits than males under both arm conditions.

Bradshaw, J. L., Gates, E. A. & Nettleton, N. C. Bihemispheric involvement in lexical decisions: Handedness and a possible sex difference. Neuropsychologia, 1977, 15, 277-286.

Twenty-four males and 24 females, 12 each right-handed and left-handed, made lexical decisions on laterally presented words, illegal consonant strings and legal non-words. The twelve right-handed females demonstrated minimal left-right field differences and were faster than males, who showed "typical left hemispheric superiority."

Bradshaw, J. L. & Gates, E. A. Visual field differences in verbal tasks: Effects of task familiarity and sex of subject. Brain and Language, 1978, 5, 166-187.

Thirty-six males and 36 females participated in four similar experiments involving a variety of laterally presented verbal material. Left hemisphere superiority was stronger for males than females, especially for overt naming rather than manual response and for familiar rather than unfamiliar material. The authors speculate that female verbal superiorities and visuospatial inferiorities may result from an invasion of right hemisphere space otherwise reserved for visuospatial processing.

Buffery, A. W. H. Sex differences in the neuropsychological development of verbal and spatial skills. In the Neuropsychology of learning disorders Knight, R. M. & Bakker, D. J. (Eds). Baltimore, MD. University Park Press 1976, pp 187-205.

One hundred male and 100 female English university students, ages 18-25 years,were tested for eye dominance and handedness at the beginning and end of a test session involving a visual-verbal and visual-spatial task. Females showed a stronger lateralization of hand preference and both verbal and spatial functioning than males. Females demonstrated a strong lateralization of visuo-spatial function associated with high verbal performance. Males demonstrated more bilateralization of function associated with high level spatial performance. Very pronounced overlaps were found in all distributions.

Davis, A. E. & Wada, J. A. Speech dominance and handedness in the normal human. Brain and Language, 1978, 5, 42-55.

Nine left speech dominant and 3 right speech dominant males and 7 left speech dominant and 3 right speech dominant females (ages 13-43, patients) plus 7 right-handed and 5 left-handed males and 5 right-handed and 5 left-handed females (no ages, normals) were presented 160 flash (visual) and 160 click (auditory) stimuli while EEG's and auditory and visual evoked potentials were recorded. Coherence was greater in the left hemisphere for auditory stimuli and right hemisphere for visual stimuli for both handeds. Right-handers and males showed significantly larger amplitudes of auditory responses in the right hemisphere and left-handers and females in the left hemisphere. The authors conclude that "males and right-handers... emphasize the verbal and temporal structure of auditory information and the non-verbal and spatial structure of visual information. Females and left-handers...tend to reverse this emphasis."

Gur, R. E. & Gur, R. C. Sex differences in the relations among handedness, sighting-dominance and eye-acuity. Neuropsychologia, 1977, 15, 585-590.

One hundred male and 100 female workers and non-psychiatric patients in General Hospital were tested for handedness. Sighting dominance was associated with handedness in males but not females. Sighting dominance was associated with visual acuity in females but not males.

Kail, R. V., Jr. & Siegel, A. W. Sex and hemispheric differences in the recall of verbal and spatial information. Cortex, 1978, 14, 557-563.

Eighteen male and 18 female university undergrads identified which hand they used for 12 common activities then focused attention on a dot on a screen. A stimulus was presented on the screen for 80 msec. Subject was required to recall letter or geometric figure, digits and position. A significant ($p < .03$) difference favoring females was found in the recall of spatial information presented to the right visual field.

Levy, J. & Levy, J. M. Human lateralization from head to foot: Sex related factors. Science, 1978, 200, 1291-1292.

Fifty-two male and 98 female (17 and 18, respectively, under age 6) shoe customers in a department store were measured for foot size and interviewed on handedness. Right-handed males had larger right than left feet and right-handed females had larger left than right feet, the difference being significant ($p < .0001$).

Martin, C. M. Verbal and spatial encoding of visual stimuli: The effects of sex, hemisphere and yes-no judgements. Cortex, 1978, 14, 227-233.

Six male and 6 female English undergrads, predominantly right-handed, performed a primarily visual and a primarily verbal task requiring yes-no comparisons of stimuli presented to right or left cerebral hemisphere. Females made faster "yes" decisions for stimuli presented to right than left hemisphere. Males made faster "yes" decisions for stimuli presented to the left than right hemisphere.

McGee, M. G. Laterality, hand preference, and human spatial ability. Perceptual and Motor Skills, 1976, 42, 781-782.

Forty-six male and 66 female university psychology students were administered a Mental Rotations Test and a handedness questionnaire. Left-handed females scored significantly ($p < .005$) lower than right-handed females on Spatial Visualization while left-handed males scored non-significantly higher than right-handed males on Spatial Visualization.

McGlone, J. & Davidson, W. The relation between cerebral speech laterality and spatial ability with special reference to sex and hand preference. Neuropsychologia, 1973, 11, 105-113.

Forty-eight secondary school students (mean age 16.8 years) and 68 university students (mean age 20.2 years) with equal numbers of right and left-handers in equally numbered male and female groups were administered a visuospatial task, a dichotic words test and a tachistoscopic dot enumeration test. Females showed poorer spatial ability and a higher incidence of right field superiority on the dot enumeration test than males suggesting to the authors that left hemisphere mediation of non-verbal activity may be disadvantageous.

McGlone, J. & Kertesz, A. Sex differences in cerebral processing of visuo-spatial tasks. Cortex, 1973, 9, 313-320.

Seventy-eight patients with unilateral brain damage and reporting right hand preference were tested for language and visuospatial abilities. Spatial performance was poorest in males with right hemisphere lesions which suggested to the authors that the right hemisphere may be more specialized for spatial processing in males than females. The correlation between verbal and block design scores was significant only for females with left hemisphere damage, suggesting to the authors that females make more use of verbal mediation of traditionally designated non-verbal tasks than do males.

McKeever, W. F. & VanDeventer, A. D. Failure to confirm a spatial ability impairment in persons with evidence of right hemisphere speech capability. Cortex, 1977, 13, 321-326.

Seventy-one left-handed and 80 right-handed university undergrads were administered tachistoscopic, dichotic, hand preference, manual skill, verbal and spatial tests. Males scored higher on the spatial test. Sex differences attributable to handedness or hemispheric language dominance were not significant.

Metzger, R. L. & Antes, J. R. Sex and coding strategy effects on reaction time to hemispheric probes. Memory and Cognition, 1976, 4, 167-171.

Ten male and 10 female undergrad psychology students were presented tachistoscopically 3-letter, concrete-noun words and required to report whether a following "probe" word appeared in the previous pair. Half the probe words were left hemisphere-verbal and half right hemisphere-spatial. Half the subjects were told to repeat paired words mentally, half to form mental images of paired words. Only instruction conditions produced significant sex differences with males responding faster under image instruction and females under rehearsal instruction ($p < .05$).

Porac, C. & Coren, S. Is eye dominance a part of generalized laterality? Perceptual and Motor Skills, 1975, 40, 763-769.

Seventy-eight males and 82 females (not otherwise identified) were administered a handedness questionnaire and three tests of eye use-sighting dominance. Males were significantly ($p < .025$) more consistent in eye preference than females. Females displayed no significant correlation between handedness and sighting dominance. Males displayed significant correlations between handedness and pointing ($p < .01$) and total sighting ($p < .05$).

Ray, W. J., Morell, M., Frediani, A. W. & Tucker, D. Sex differences and lateral specialization of hemispheric function. Neuropsychologia, 1976, 14, 391-394.

Six right handed male and 6 right handed female graduate and undergrad students performed 4 tasks designed to utilize the left hemisphere and 4 tasks to utilize the right. EEG measurements taken from the temporal lobes showed a significant difference between left and right tasks for males but not females. The authors interpret the result to suggest males and females process the same environmental event with different patterns of brain activity.

Tucker, D. M. Sex differences in hemispheric specialization for synthetic visuospatial functions. Neuropsychologia, 1976, 14, 447-454.

Twenty male and 19 female right-handed university undergrads performed a visuospatial task requiring perceptual synthesis, a visuospatial task requiring perceptual analysis and a vocabulary task. EEG records were interpreted as indicating a right hemisphere specialization for the synthesis task in males and disychrony for the analysis and vocabulary tasks in females.

LATERALITY SUMMARY

Males	Females
Hemispheric specialization	Hemispheric equality
Visual-Spatial functioning	Visual-Verbal functioning
Verbal & temporal structuring of auditory information	Verbal & temporal structuring of visual information
Non-verbal & spatial structuring of visual information	Non-verbal & spatial structuring of auditory information
Handedness and sigh dominance correlated	Handedness and sight dominance not correlated
EEG amplitudes higher for auditory stimuli to right hemisphere	EEG amplitudes higher for auditory stimuli to left hemisphere
Temporal lobe EEGs different for right and left hemisphere tasks	Temporal lobe EEGs not different for right and left hemisphere tasks
Right hemisphere specialization of perceptual synthesis processing	Disychrony of hemisphere in perceptual analysis and vocabulary processing
Faster yes-no decisions from left hemisphere stimulation	Faster yes-no decisions from right hemisphere stimulation
Better recall of visual stimuli by mental visualizations of stimuli	Better recall of visual stimuli by mental repetition of stimuli
Left-handeds higher than right-handeds on Spatial Visualization	Left-handeds lower than right-handeds on Spatial Visualization
Eye acuity not correlated with sighting dominance	Eye acuity correlated with sighting dominance
Right-handeds have larger right than left feet	Right-handeds have larger left than right feet

INTELLIGENCE-GENERAL ACADEMIC ABILITY

Backman, M. E. Patterns of mental abilities: Ethnic, socioeconomic, and sex differences. American Educational Research Journal, 1972, 9, 1-12.

Achievement and aptitude scores of 2925 high school seniors from among participants in the 1960 Project TALENT were factored to produce 11 orthogonal ability factors. Six mental ability factors were examined for presence of a variety of differentiating patterns. Six were significantly ($p < .001$) related to both the shape and levels of patterns, the relation of sex to shape accounting for 69% of the variance. Females received higher mean scores on English Language, Perceptual Speed and Accuracy and Short-Term Memory while males had higher mean scores on Verbal Knowledge, Mathematics and Visual Reasoning. Other main effects and interactions were relatively minor.

Bieri, J., Bradburn, W. & Galinsky, M. Sex differences in perceptual behavior. Journal of Personality, 1958, 26, 1-12.

Seventy-six college students, ages 18-21 years, were compared on the basis of their Scholastic Aptitude Test scores. Males had higher quantitative scores than females but there were no significant differences on verbal scores.

Cobb, B. B., Mathews, J. J. & Lay, C. D. A comparative study of female and male air traffic controller trainees (Report No. FAA-AM-72-22). Oklahoma City, OK: FAA Civil Aeromedical Institute, May 1972.

Samples from 3,760 males and all 83 females entering FAA Academy Air Traffic Control training from November 1968 through March 1970. Compared males and females on age, education, pre-FAA experience, 36 aptitude-ability tests, training attrition, and post-training attrition. Females performed significantly better than males on Number Facility ($p < .01$), Non-Verbal Abstract Reasoning ($p < .05$) and a Symbol-to-Digit test ($p < .01$). The only other statistically significant sex difference found was that post-training attrition was significantly higher for females than males (level not given).

DeFazio, V. J. Field articulation differences in language abilities. Journal of Personality and Social Psychology, 1973, 25, 351-356.

Twenty-two male and 22 female college students (ages 18-21 years) were administered Word Beginnings and Endings Test, Advanced Vocabulary Test, Cloze Test and Shadowing Test. No significant differences between males and females were found.

Droege, R. C. Sex differences in aptitude maturation during high school. Journal of Counseling Psychology, 1967, 14, 407-411.

The General Aptitude Test Battery was readministered to 20,541 students in grade 12 who had previously been tested in grades 9, 10 and 11. Data was also obtained for 6,167 students previously tested in grade 12. No sex differences in increases in aptitude scores attributable to practice and maturation were found. Correlations between initial and retest scores were also about the same for both sexes.

Fennema, E. & Sherman, J. Sex-related differences in mathematics achievement, spatial visualization and affective factors. American Educational Research Journal, 1977, 14, 51-71.

Six-hundred-forty-four male and 589 female 12th grade students in 4 Wisconsin high schools were administered battery of tests (not identified). The authors concluded that "the data do not support either the expectations that males are invariably superior in mathematics achievement and spatial visualization or the idea that differences between the sexes increase with age and/or mathematics difficulty... The sex related differences were small and score distributions overlapped considerably. The pattern of differences in mathematics achievement, spatial visualization and affective variables strongly suggests the influence of socio-cultural factors."

Gross, A. L., Faggen, J. & McCarthy, K. The differential predictability of the college performance of males and females. Educational and Psychological Measurement, 1974, 34, 363-365.

College Freshman Grade Point Averages of 82 to 953 male and 62 to 674 female college Freshman in each of 10 undergraduate colleges of the City University of New York were predicted from six high school scores. The predictor score means and standard deviations were basically the same for males and females although females, on the average, had higher GPAs. The GPAs for females could be predicted more accurately than for males.

Guttman, R. Genetic analysis of analytical spatial ability: Raven's progressive matrices. Behavior Genetics, 1974, 4, 273-284.

One hundred fathers, 100 mothers, 89 sons, and 119 daughters in Jerusalem and Tel Aviv were administered the 1961 Raven Progressive Matrices, standard book form. Differences were noted (degree or significance not given) between sexes and generations with fathers scoring highest, sons next, then daughters and finally mothers on most sub-tests.

Hyde, J. S., Geiringer, E. R. & Yen, W. M. On the empirical relation between spatial ability and sex differences in other aspects of cognitive performance. Multivariate Behavioral Research, 1975, 10, 289-309.

Thirty-five male and 46 female university undergrads were administered: Identical Blocks Test, Group Embedded Figures Test, Mental Arithmetic Test, Word Fluency Test, Alternate Uses Test, Femininity scale, an Achievement Motivation Test, Rod and Frame Test and the Vocabulary subtest of the WAIS. Significant differences in mean scores favoring males were found for Spatial Ability ($p = .057$), Mental Arithmetic ($p = .035$) and Rod and Frame ($p = .015$). Significant mean score differences favoring females were found for Vocabulary ($p = .001$), Word Fluency ($p < .001$), Alternate Uses ($p = .002$), Femininity ($p < .001$) and the IQ Equivalent of Vocabulary ($p = .005$). After removing differences in Vocabulary, males maintained significant superiority in Spatial Ability, Rod and Frame and Mental Arithmetic while females maintained significant superiority on Word Fluency, Alternate Uses and Femininity. Removal of differences in Spatial Ability left the males superior on none and the females significantly superior on the Embedded Figures, Vocabulary, Word Fluency, Alternative Uses and Femininity.

Reese, A. H. & Palmer, F. N. Factors related to change in mental test performance. Developmental Psychology Monograph, 1970, 3.

Six-hundred-twenty-two subjects were utilized. Sub-samples, for longitudinal or cross-sectional comparisons, were administered the Stanford Binet and/or Wechsler-Bellevue intelligence tests. No sex differences were found on the Stanford Binet for ages 6 and 12, but 17 year males scored higher than 17 year females. No sex differences were found on the Wechsler-Bellevue Full Scale or Performance subtest but males scored higher on the Verbal subtest.

Very, P. S. Differential factor structures in mathematical abilities. Genetic Psychology Monographs, 1967, 75, 169-207.

Three-hundred-fifty-five college students, ages 18-21 years, were administered a battery of mathematical, verbal and spatial tests. Females scored higher than males on Logical Reasoning, Number Comparisons, Visual Motor Velocity, Moore-Castore Vocabulary and Paragraph Reading, and English Placement Vocabulary. Males scored higher than females on Division, Arithmetic Reasoning, Mathematical Aptitude, General Reasoning, Spatial Relations, Cards, Cubes, Spatial Orientation, Judgment, and Moore-Castore Arithmetic and Algebra.

Waber, D. P. Sex differences in mental abilities, hemispheric lateralization, and rate of physical growth at adolescence. Developmental Psychology, 1977, 13, 29-38.

Seventy-six college students, ages 18-21 years, were compared on the basis of their Scholastic Aptitude Test scores. Males had higher quantitative scores than females but there were no significant differences on verbal scores.

INTELLIGENCE-GENERAL ACADEMIC ABILITY SUMMARY

Type	Number of Citations Reporting Male Superiority	No Differences	Female Superiority
Stanford-Binet	1		
WAIS-Full Scale		1	
Raven Progressive Matrices	1		
Vocabulary		4	4
Verbal	2	2	1
Mathematics	7		2
Spatial	5	1	
Reasoning	3		2

Allen, M. J. Sex differences in spatial problem-solving styles. Perceptual and Motor Skills, 1974, 39, 843-846.

Forty-six male and 47 female college psychology students were administered a battery of six spatial tests from the Kit of Reference Tests for Cognitive Factors representing Spatial Orientation, Spatial Scanning and Spatial Visualization. They were also administered a brief, un-timed test of similar (alternate) problems and a list of 14 to 20 strategies, to be checked if used on specific problems. Males scored significantly better than females on all tests except Paper Folding and Surface Development, on which they scored not significantly better.

Bock, R. D. & Kolakowski, D. Further evidence of sex-linked major-gene influence on human spatial visualizing ability. American Journal of Human Genetics, 1973, 25, 1-14.

One-hundred-sixty-seven families, parents and children 12 years or older were administered the Guilford-Zimmerman Spatial Visualization Test. The correlation between fathers and daughters was higher than between fathers and sons and between mothers and sons were greater than mothers and daughters.

Bouchard, T. J., Jr. & McGee, M. G. Sex differences in human spatial ability: Not an X-linked recessive gene effect. Social Biology, 1977, 24, 332-335.

Three-hundred-ninety-six male and 405 female, college students and their parents representing 200 families were administered the Mental Rotation Test of spatial visualization. Males scored significantly ($p < .001$) higher than females within each generation.

Castore, C. H. & Stafford, R. E. The effect of sex role perception on test taking performance. Journal of Psychology, 1970, 74, 175-180.

Four-hundred-sixty-two college freshman were administered the Identical Blocks Test and one of 3 forms of a spatial vizualization test; neutral "Pattern Development," masculine "Drafting Aptitude" or feminine "Fashion Design Aptitude". Males performed significantly better than females on the Identical Blocks Test and on all three forms of the spatial visualization test.

Davies, A. D. M. The perceptual maze test in a normal population. Perceptual and Motor Skills, 1965, 20, 287-293.

Fifty males and 40 females in each decade age group, 20-29 to 70-79 years, were presented 18 Perceptual Maze Tests including three maze sizes and 3 saturation levels. Males scored significantly ($p < .01$) more mazes correct than females in all age decades except the older two where males scored not-significantly ($p > .05$) more correct than females.

Droege, R. C. Sex differences in aptitude maturation during high school. Journal of Counseling Psychology, 1967, 14, 407-411.

The US Employment Service 1958 General Aptitude Test Battery was administered to 20,151 students, ages 14-16 years, in grades 9, 10, and 11 and retested at age 17 in grade 12. An additional 6,167 12th graders, age 17, were administered the Battery. In every comparison males scored higher than females on intelligence and spatial ability.

Fennema, E., & Sherman, J. Sex-related differences in mathematics achievement, spatial visualization and affective factors. American Educational Research Journal, 1977, 14, 51-71.

Six-hundred-forty-four male and 589 female high school students, grades 9-12, were administered a battery of tests in school. The authors concluded that "The data do not support either the expectations that males are invariably superior in mathematics achivement and spatial visualization or that the differences between the sexes increase with age. The sex-related differences were small and score distributions overlapped considerably suggesting the influence of socio-cultural factors."

Geiringer, E. R., & Hyde, J. S. Sex differences on Piaget's water-level task: Spatial ability incognito. Perceptual and Motor Skills, 1976, 42, 1323-1328.

Thirty male and 30 female high school seniors were administered Thurstone's Spatial Relations Test and a water-level task. Males performed significantly better than females on the Spatial Relations Test ($p < .02$) and the water-level task ($p < .025$).

Goldberg, J., & Meredith, W. A. A longitudinal study of spatial ability. Behavior Genetics, 1975, 5, 127-135.

Seventy-six high school students, racially mixed, slightly more females than males, who had taken at least one of five of Tuddenham's Piagetian Tests of spatial ability in elementary school were retested. Males scored higher than females on all parts of the test except P3 and PR3 but significantly ($p < .05$) so only on sections PR5 and S4.

Groberg, D. H., Dustman, R. E., & Beck, E. C. The effect of body and head tilt in the perception of vertical: Comparison of body and head tilt with left and right handed, male and female subjects. Neuropsychologia, 1969, 7, 89-100.

Four experiments were reported using a laterally tilting chair and head holder: (1) Eleven subjects were tested to investigate differences between body and head tilt on perception of vertical, (2) twelve subjects were tested and retested after one year to determine reliability of estimates of vertical, (3) twenty subjects were tested to study differences between visual and postural estimates of vertical, and (4) twelve each right- and left-handed males and ten each right- and left-handed females were tested to determine effects of lateralization of hand usage on verticality estimates. No sex differences associated with head or body tilt were found. But there was a significant difference in the effect of the starting position of the rod, a left starting position having a greater effect on females and a right starting position on males.

Gupta, G. C. Effect on lateral body tilts and visual frames on perception of the apparent vertical. Journal of Experimental Psychology, 1973, 100, 162-167.

A total of 60 male and 60 female college students, ages 19-22 years, were used in three experiments investigating the effect of body tilt and visual frame on the setting of a rod to apparent vertical. Experiment I investigated lateral tilt, Experiment II replicated Experiment I with highly selected body tilts and Experiment III studied tilts in the forward-backward plane. Males performed significantly better in all three experiments.

Harris, L. J. Sex differences in spatial ability: Possible environmental, genetic, and neurological factors. In Kinsbourne, M. (Ed.). Asymmetrical Function of the Brain. Cambridge, Cambride University Press, 1978, p 405-522.

Review of research on spatial ability. The author concludes that males have demonstrated decidedly greater spatial skills than females, on a number of tests only 20-25% of females exceeding the mean performance of males. Males are superior in static visualization, such as coding and recollection and disembedding shapes, and on dynamic visualization, such as visualizing a 3-dimensional form from a 2-dimensional pattern and the rotation of a form in space. While there are no appreciable sex difference (females may even be superior) on simple, repetitive arithmetic tasks, males are somewhat superior on algebra and much superior on geometry. Males surpass females on visual and tactual mazes and map reading. On complex spatial tasks such as rotary pursuit, males are initially better than females, develop skill faster and reach higher maximum performance than females. But the author finds "some evidence that spatial skill can be improved with training" and suggests that females might be brought up to the male level of performance if allowed to share in appropriate experiences.

Hartlage, L. C. Sex-linked inheritance of spatial ability. Perceptual and Motor Skills, 1970, 31, 610.

One hundred subjects, ages 16-56 years, representing 25 families and encompassing all combinations of father-son, father-daughter, mother-son, mother-daughter, were administered the space section of the Differential Aptitude Test. Significant correlations ($r = .34$) were found between mothers and sons ($p < .025$) and fathers and daughters ($p < .05$). Other correlations were not significant.

Hyde, J. S., Geiringer, E. R. & Yen, W. M. On the empirical relation between spatial ability and sex differences in other aspects of cognitive performance. Multivariate Behavioral Research, 1975, 10, 289-309.

Thirty-five male and 46 female undergrad college students were administered nine tests, including Identical Blocks Test, Group Embedded Figures Test, Mental Arithmetic Test and Rod and Frame Test. Significant mean score differences favoring males over females were found for spatial ability ($p = .057$), mental arithmetic ($p = .035$) and Rod and Frame Test ($p = .015$). After removal of vocabulary differences, males were still superior on spatial ($p = .016$), Rod and Frame ($p = .023$) and mental arithmetic ($p = .005$), but removal of spatial abilities differences extinguished all male superiorities.

Loehlin, J. C., Sharan, S. & Jacoby, R. In pursuit of the "spatial gene": A family study. Behavior Genetics, 1978, 8, 27-41.

Members of 192 families in the Tel Aviv area consisting of father, mother and 2 children over 13 years were administered a battery of eight cognitive tests emphasizing spatial measures but also sampling verbal, numerical and perceptual speed factors. Males showed a large and significant superiority on spatial measures and a smaller but significant superiority on numerical measures.

McGee, M. G. Laterality, hand preference, and human spatial ability. Perceptual and Motor Skills, 1976, 42, 781-782.

Forty-six male and 66 female college psychology students were administered a Mental Rotations Test and a Handedness questionnaire. Males were significantly ($p < .005$) superior to females on the Mental Rotations Test.

McGee, M. G. Human spatial abilities: Psychometric studies and environmental genetic, hormonal and neurological influences. Psychological Bulletin, 1979, 86(5), 889-918.

A research review concluded that there are two distinct spatial abilities: Spatial Visualization, the ability mentally to rotate, manipulate and twist two and three-dimensional stimulus objects, and Spatial Orientation, the ability to comprehend the arrangement of elements within a visual stimulus, to remain unconfused by changing orientations in which the configuration may be presented and to determine the orientation of a stimulus with respect to one's own body. The author concludes that males persistently performed superior to females on both spatial abilities.

McGlone, J. & Davidson, W. The relation between cerebral speech laterality and spatial ability with special reference to sex and hand preference. Neuropsychologia, 1973, 11, 105-113.

Forty-eight secondary school students, mean age 16.8 years, and 68 university students, mean age 20.2, 58 males and 58 females, half of each being right-handed and half left-handed, completed two visuospatial tasks, a dichotic words test and a tachistoscopic dot enumeration test. Females showed poorer spatial ability and a higher incidence of right cerebral hemisphere superiority on the dot enumeration test than males.

McKeever, W. F. & Van Deventer, A. D. Failure to confirm a spatial ability impairment in persons with evidence of right hemisphere speech capability. Cortex, 1977, 13, 321-326.

Eighty right-handed and 71 left-handed undergrad college students were administered tachistoscopic, dichotic, manual preference, manual skill, verbal and spatial tests. Males scored significantly higher on the spatial test. Male-female differences due to handedness or hemispheric language dominance were not significant.

Petrusic, W. M., Varro, L. & Jamieson, D. G. Mental rotation validation of two spatial ability tests. Psychological Research, 1978, 40, 139-148.

Sixteen male and 16 female college students, ages 18-54 years, were administered a speeded mental rotation test, Card Rotation Test and Revised Minnesota Form Board Test. Males were strongly superior to females on the Speeded mental rotation and Card Rotation tests but differences on the Form Board were not significant.

Pitblado, C. Superior performance by women in a visual orienting task: A limit on the concept of field dependence. Perceptual and Motor Skills, 1976, 42, 1195-1200.

Twenty-four male, ages 21-60 years, and 15 female, ages 18-48 years, employees of Institute for Living were used. Subjects lay on table tilted 70° relative to vertical with head supported by pillow, closed eyes. Experimenter rotated a rod painted to glow in totally darkened room. Subject opened eyes in darkened room, report when Experimenter has moved rod to vertical. Males made significantly greater errors than females whether lying tilted to left ($p < .01$) or right ($p < .001$).

Ridgeway, C. L. Patterns of environmental adjustments underlying measured cognitive complexity and field independence in men and women. Perceptual and Motor Skills, 1977, 44, 99-112.

Seventy-two male and 73 female college psychology students were administered Driver's Integration Style Test of decision styles, a Hidden Figures Test, and a variety of questionnaire instruments. Males tended (not significantly) to score higher on Hidden Figures Test of spatial analytic ability.

Sherman, J. A. Field articulation, sex, spatial visualization, dependency, practice, laterality of the brain and birth order. Perceptual and Motor Skills, 1974, 38, 1223-1235.

Twenty-five male and 25 female undergrad psychology students, mean ages 23.40 and 23.65 respectively, were administered the Rod and Frame Test, Group Embedded Figures Test, Draw-a-Person Test and a Space Relations Test. Male spatial visualization was significantly better ($p < .05$) than female's.

Sherman, J. A. & Fennema, E. Distribution of spatial visualization and mathematical problem solving scores: A test of Stafford's X-linked hypotheses. Psychology of Women Quarterly, 1978, 3, 157-167.

One-hundred-sixty-one male and 152 female 9th grade students were administered the Space Rotations Test of The Differential Aptitude Test along with mental arithmetic problems. No significant differences were found between male and females.

Stafford, R. E. Sex differences in spatial visualization as evidence of sex-linked inheritance. Perceptual and Motor Skills, 1961, 13, 428.

One hundred fathers and mothers and their 58 teenage sons and 70 teenage daughters were administered the Identical Blocks Test of spatial visualization. Males scored significantly higher than females whether parent or child.

Tapley, S. M. & Bryden, M. P. An investigation of sex differences in spatial ability: Mental rotation of three-dimensional objects. Canadian Journal of Psychology, 1977, 31, 122-130.

Twenty male and 20 female subjects were presented pairs of three-dimensional objects, rotated 0^{o}, 40^{o}, 80^{o}, 120^{o} or 160^{o} one from the other and given 15 seconds for a same-differenct response. Males were significantly more accurate than females.

Vanderberg, S. G. & Kuse, A. R. Mental rotations, a group test of three-dimensional spatial visualization. Perceptual and Motor Skills, 1978, 47, 599-604.

Reports development of a paper-and-pencil spatial visualization Mental Rotations Test. Males consistently tested superior to females over the entire range of ages.

Very, P. S. Differential factor structures in mathematical abilities. Genetic Psychology Monographs, 1967, 75, 169-207.

Three-hundred-fifty-five college students, ages 18-21 years, were administered a battery of mathematical, verbal and spatial tests. Males scored significantly higher than females on Spatial Relations, Cards, Cubes, Spatial Orientation.

Wolf, V. C. Age and sex performance differences as measured by a new nonverbal visual perceptual test. Psychonomic Science, 1971, 25, 85-87.

Thirty-seven male and 37 female high school 11th graders were administered Wolf's Embedded Figures Test, a Vocabulary Test and a new Spatial Perceptual Test. Males scored higher than females on the Embedded Figures Test and the Spatial Perceptual Test, but when the sex differences on spatial perception were covaried out, the Embedded Figures sex differences disappeared.

Yen, W. M. Independence of hand preference and sex-linked genetic effects on spatial performance. Perceptual and Motor Skills, 1975, 41, 311-318.

One-thousand-two-hundred-thirty-six male and 1241 female high school students were administered four paper-and-pencil tests of spatial abilities and asked which hand they used to mark answers. Males scored significantly higher than females on all tests ($p < .001$) except that left-handed females scored slightly, not significantly better than left-handed males on Paper Folding.

SPATIAL ABILITY SUMMARY

Type	Number of Citations Reporting Male Superiority	No Differences	Female Superiority
	Male Superiority	No Differences	Female Superiority
Ability	8	1	
Visualization	12		
Orientation	3	1[α]	
Scanning	2		

[α]Males affected by an initial right position; females affected by initial left position of a rod.

VERBAL ABILITY

Backman, M. E. Patterns of mental abilities: Ethnic, socioeconomic, and sex differences. American Educational Research Journal, 1972, 9, 1-12.

Background data and achievement and aptitude test scores of 2925 high school 12th graders, participants in the 1960 Project TALENT, were used to identify orthogonal ability factors which were analyzed for the presence of factors among sex, ethnic and socio-economic groups. Sex was significantly ($p < .001$) related to both the shape and levels of patterns, the relation of sex to shape accounting for 69% of the total variance. Females had higher mean scores than males on: English Language, Perceptual Speed and Accuracy and Short-Term Memory. Males had higher mean scores than females on Verbal Knowledge, Mathematics and Visual Reasoning. Author speculated that social factors might affect some differences, e.g., Verbal Knowledge was loaded with sports, military and electronics topics and Mathematics was loaded with higher math (beyond 9th grade algebra) items.

Barr-Brown, M. & White, M. J. Sex differences in recognition memory. Psychonomic Science, 1971, 25, 75-76.

Six male and 6 female high school students, mean age 16 years, were presented tachistoscopically a list of fifty 6-letter, 2-syllable words (1 sec per word, 5 secs between words). Indicated whether each word in a second list of 50 words was "new" or "old" (previously viewed) and to rate confidence in decision. No differences were found between males and females.

Bieri, J., Bradburn, W. & Galinsky, M. Sex differences in perceptual behavior. Journal of Personality, 1958, 26, 1-12.

Seventy-six college students, ages 18-21 years, were compared on the basis of their Scholastic Aptitude Test scores. Males had higher quantitative scores than females but there were no significant differences in verbal scores.

Bradshaw, J. L., Gates, E. A. & Nettleton, N. C. Bihemispheric involvement in lexical decisions: Handedness and a possible sex difference. Neuropsychologia, 1977, 15, 277-286.

Twelve male and 12 female right-handers and 12 male and 12 female left-handers made lexical decisions to laterally presented words, "illegal" consonant strings and "legal" nonwords. The right-handed females were faster than right-handed males. Authors suggest that female hemispheric equipotentiality in language may account for their visuospatial inferiority to the extent that language has partially invaded their right hemispheric space.

Buffery, A. W. H. Sex differences in the neuropsychological development of verbal and spatial skills. In the Neuropsychology of learning disorders. Knight, R. M. & Bakker, D. J. (Eds). Baltimore, MD. University Park Press 1976 pp 187-205.

One hundred male and 100 female English university students, age 18-25 years, performed two visual matching tasks, one verbal (matching words) and one spatial (matching characters). Authors reported "a high level of performance in the (verbal) task...was characteriistic of women" and "a high level of performance in the (spatial) task...was characteristic of men..." No statistical comparisons were reported but tabled distributions showed very pronounced overlaps.

DeFazio, V. J. Field articulation differences in language abilities. Journal of Personality and Social Psychology, 1973, 25, 351-356.

Twenty-two male and 22 female college students, ages 18-21 years, were administered a Word Beginnings and Endings Test, an Advanced Vocabulary Test, a Cloze Test (identify missing words in a paragraph) and a Shadowing Test (repeat sentences or strings of words after being read to). No sex differences were found.

Droege, R. C. Sex differences in aptitude maturation during high school. Journal of Counseling Psychology, 1967, 14, 407-411.

The scores of 20,541 students, ages 14-17 years, tested with the U.S. Employment Service 1958 General Aptitude Test Battery in grades 9, 10 and 11 and retested in grade 12, plus 6,167 students previously tested in grade 12, were examined for maturational trends. In every comparison males scored higher than females on intelligence and spatial aptitude; females scored higher than males on verbal aptitude, form perception, clerical perception, motor coordination and finger dexterity.

Hyde, J. S., Geiringer, E. R. & Yen, W. M. On the empirical relation between spatial ability and sex differences in other aspects of cognitive performance. Multivariate Behavioral Research, 1975, 10, 289-309.

Thirty-five male and 46 female undergrad university students were administered 7 paper and pencil aptitude/ability tests, a field dependence test and the Vocabulary subtest of the WAIS. Mean scores for females were significantly higher than those of males on Vocabulary ($p < .005$) and Word Fluency ($p < .001$). After removing differences in Vocabulary, females remained superior to males on Word Fluency ($p < .001$). After removing differences in Spatial Ability, females remained superior to males on Vocabulary ($p < .002$) and Word Fluency ($p < .001$).

Johnson, O. & Kozma, A. Effects of concurrent verbal and musical tasks on a unimanual skill. Cortex, 1977, 13, 11-16.

Nine male and 9 female right-handed college students balanced a dowel rod on right or left finger while speaking, humming, and silent. Males' balancing time for right hand decreased with concurrent speaking. Verbalization had no effect on male left hand performance or for either hand by females. Humming had no effect on either sex.

Michaelis, P. R. Cooperative problem solving by like- and mixed-sex terms in a teletypewriter mode with unlimited, self-limited, introduced and anonymous conditions (Technical Report-9). Baltimore, MD: Johns Hopkins University. (Contract No. N00014-75-C-0131)

Forty-eight male and 48 female university undergrad students engaged in a task in which a "Source" instructed a "Seeker" how to assemble a "Tinkertoy" model using a teletypewriter as the only channel of communication. Even numbers of same-sex and mixed-sex two-person teams, half introduced, half not, were assigned to conditions of penalty for each word used or not penalized. There were no differences between like- or mixed-sex teams, introduced or anonymous, or attributable to sex of "Seeker." Females were superior to males as "Sources" in terms of time to complete model and number of words used.

Reese, A. H. & Palmer, F. N. Factors related to change in mental test performance. Developmental Psychology Monograph, 1970, 3.

Six-hundred-twenty-two students, ages 6, 12 and 17 years, were tested with the Stanford-Binet and/or Wechsler-Bellevue intelligence tests, with subsamples compared cross-sectionally or longitudinally. Males scored higher than females on the Stanford-Binet at age 17 but there were no sex differences at ages 6 and 12. Males scored higher on the Wechsler-Bellevue-Verbal but there were no sex differences on the Full Scale or Performance sub-scale.

Suter, W. N. Free recall as a function of instructional set, imagery level, and sex. Perceptual and Motor Skills, 1979, 48, 535-538.

Thirty-two male and 32 female college students were presented tachistoscopically lists of 21 two-syllable words of high, medium or low imagery under one of 4 instruction conditions: no instruction, form visual image of words, link words to something familiar, both visualize and link. The link-image condition was significantly ($p < .10$) superior to the other three. Females recalled significantly ($p < .01$) more words than males.

Very, P. S. Differential factor structures in mathematical abilities. Genetic Psychology Monographs, 1967, 75, 169-207.

Three-hundred-fifty-five college students, ages 18-21 years, were administered a battery of mathematical, verbal and spatial tests. Females scored higher than males on Logical Reasoning, Number Comparison, Visual Motor Velocity, Moore-Castore Vocabulary, Moore-Castore Paragraph Reading and English Placement Vocabulary.

VERBAL ABILITY SUMMARY

Type	Number of Citations Reporting		
	Male Superiority	No Differences	Female Superiority
Language			1
Verbal Aptitude	1	1	1
Vocabulary		1	2
Verbal Knowledge	1[α]		
Word Fluency			1
Word Recognition/Recall		1	3
Language Usage			1

[α]Loading of sports, military, electronics items may have favored males.

PROBLEM SOLVING

Allen, M. J. Sex differences in spatial problem-solving styles. Perceptual and Motor Skills, 1974, 39, 843-846.

Forty-six male and 47 female college psychology students were administered a battery of spatial tests from the Kit of Reference Tests for Cognitive Factors and a brief, untimed test of similar alternate problems, and a checklist of possible strategies to be checked if used on specific problems. Strategies showing significant sex differences were mostly general in nature, i.e., general problem-solving orientation. Females used "No Particular Strategy" or "Guessing" more than males. Where there were sex differences in test specific strategies, females' tended to be less efficient than males'.

Allen, M. J. & Hogeland, R. Spatial problem-solving strategies as functions of sex. Perceptual and Motor Skills, 1978, 47, 348-350.

Fifty male and 50 female college summer students and friends of experimenters, ages 18-45 years, were administered the Rod and Frame Test and Choosing-A-Path Test, each followed by a strategies questionnaire. Males were significantly more accurate than females on both tasks. Females were more likely than males to use concrete and unorganized strategies and to give up or skip problems.

Burke, R. J. Sex differences in recognizing the correct answer to a problem. Psychological Reports, 1965, 17, 532-534.

Forty-three male and 38 female college psychology students were administered Maier's Horse Trading Problem. Significantly ($p < .01$) greater percentage of males than females solved the problem correctly.

Carey, G. L. Sex differences in problem-solving performance as a function of attitude differences. Journal of Abnormal and Social Psychology, 1958, 56, 256-260.

One-hundred-forty-four college students, ages 18-21 years were administered a series of problem solving tasks and an attitude-toward-problem-solving scale before and after a pro-problem solving discussion. Males initially had a more favorable, positive problem solving attitude than females but sex differences disappeared after the discussion. Females performed significantly ($p < .02$) better on the second set of problems but males showed no significant ($p > .05$) improvement.

Duncan, C. P. Probability vs. latency of solution of an insight problem. Psychological Reports, 1962, 10, 119-121.

One-thousand-eighty-eight adults were administered Maier's 2-string Problem. Significantly more males than females solved the problem within the specified time.

Eimas, P. D. Information processing in problem solving as a function of developmental level and stimulus salience. Developmental Psychology, 1970, 2, 224-229.

One-hundred-ninety-two school children, ages 7, 9, 11, 13, and 48 college women, ages 18-21, were shown 8- and 16-cell matrices containing one of three types of stimuli. Their task was to identify the correct cell as quickly as possible by asking questions answerable by yes or no. Questions were analyzed for average amount of information elicited, categoricalness and focusing. No sex differences were found.

Heyn, J. E., Barry, J. R. & Pollack, R. H. Problem-solving as a function of age, sex, and the role appropriateness of the problem content. Experimental Aging Research, 1978, 4, 505-519.

Eight males and 8 females in each of three age groups, 20-30 years, 40-50 years, 60-70 years (total 48) were administered 20 problems from the problem-solving literature, all without time limit. No significant sex differences were found.

Hoffman, L. R. & Maier, N. R. F. Sex differences, sex composition, and group problem solving. Journal of Abnormal and Social Psychology, 1961, 63, 453-456.

One-hundred-ninety-four male and 194 female university lower classmen were assigned to one of three 4-person groups: All male, all female, 2male-2female. Subjects solved Horse Trading Problem alone, then went to group for 8-minute discussion of problem, finally wrote down individual solution. Significantly more males (53.1%) than females (25.8%) solved the problem correctly initially. Significantly more males (84.8%) than females (60.1%) solved the problem correctly after discussion. A significantly higher proportion of males than females changed from an incorrect to correct solution after discussion (75.6%/51.4%). A not significantly high proportion of females than males changed from an initially correct to an incorrect solution after discussion (14.3%/6.9%).

Hoffman, L. R. & Maier, N. R. F. Social factors influencing problem solving in women. Journal of Personality and Social Psychology, 1966, 4, 382-390.

Seventy-three male and 243 female college psychology students were administered the Horse Trading Problem and 8 arithmetic and logical reasoning problems (half of subjects given "masculine" version of reasoning problems and half "feminine" version). Female Experimenters conducted testing sessions of all-female subjects. Female or male Experimenters conducted mixed sessions. An additional 62 male and 62 female "motivated" and 62 female "control" students were administered the Horse Trading Problem by male experimenters. Males performed significantly ($p < .01$) better than females on the eight reasoning problems until mathematical aptitude was statistically controlled and the differences dropped below significance ($p > .05$). Males performed better ($p < .01$ to $p < .001$) on the Horse Trading Problem.

Leskow, S. & Smock, C. D. Developmental changes in problem solving strategies. Developmental Psychology, 1970, 2, 412-422.

Ninety-six students, ages 12, 15 and 18 years, were given four sets of four stimuli and required to find all possible arrangements without repetition. No differences between the sexes were found.

Maier, N. R. F. & Burke, R. J. Response availability as a factor in the problem-solving performance of males and females. Journal of Personality and Social Psychology, 1967, 5, 304-310.

A series of six experiments utilizing college undergrads as subjects was reported:

I: Eighty-seven males and 86 females were administered the standard Horse Trading Problem. Significantly ($p < .01$) more females than males chose incorrect "Broke Even" solution. Significantly ($p < .01$) more males than females chose correct "Made $20."

II: Forty-three males and 83 females were administered the Horse Trading Problem with rationales for each alternative answer. Results were identical to those of Experiment I.

III: Forty-two males and 72 females were administered the Horse Trading Problem but with the "Broke Even" alternative response eliminated. No sex differences were found.

IV: Forty-four males and 44 females were administered the Horse Trading Problem revised to make "Broke Even" the correct solution. No sex differences were found.

V: Sixty-four males and 50 females were administered a Used Car Problem (Man bought car-wife didn't like it-man sold car. Financial result?) for which there is no correct solution. Significantly ($p < .01$) more males than females chose "Lost Money." Significantly ($p < .01$) more females than males chose "Broke Even."

VI: Thirty-four males and 35 females were administered the Used Car Problem with the wife "buying and selling." Significantly more males than females chose "Lost Money" ($p < .05$) and more females than males chose "Broke Even" ($p < .01$).

Maier, N. R. F. & Casselman, G. G. Locating the difficulty in insight problems: Individual and sex differences. Psychological Reports, 1970, 26, 103-117.

Three-hundred-eleven male and 233 female college psychology students were administered both standard and simplified versions of Horse Trading Problem, Gold Chain Problem, Nine-Dot Problem, Prisoner Problem, Train Problem, and Farmer Problem from problem solving literature. Males performed significantly better (range $p < .05$ to $p < .001$) on 11 of the 12 problems. Females performed not significantly better than the males on the Standard Farmer Problem.

Michaelis, P. R. Cooperative problem solving by like- and mixed-sex teams in a teletypewriter mode with unlimited, self-limited, introduced and anonymous conditions (Technical Report-9). Baltimore, MD: Johns Hopkins University. (Contract No. N00014-75-C-0131)

Forty-eight male and 48 female university undergrads were assigned to one of four 2-person teams: Both male, both female, male "Source" - female "Seeker", female "Source" - male "Seeker". Task was for Source to instruct Seeker in assembly of a "Tinkertoy" model using a teletypewriter as the only means of intercommunication. Half the teams were penalized for each word used, other half not penalized. Half the teams were introduced to each other, half not introduced. No differences were found between like- and mixed-sex team performance, between introduced and anonymous teams, attributable to sex of "Seeker." BUT females were significantly superior to males as "Sources."

Milton, G. A. Sex differences in problem solving as a function of appropriateness of the problem content. Psychological Reports, 1959, 5, 705-708.

Twenty-four male, mean age 20.7, and 24 female, mean age 20.4, college undergrads were administered 20 problem-solving problems: Ten (from twenty) conventional male-oriented problems and ten (from twenty) female-oriented adaptations of standard male-oriented problems. Males, on the average, solved significantly more male-oriented ($p < .001$) as well as female-oriented ($p < .05$) problems than females.

Fishkin, V., Wolfgang, A. & Rasmussen, E. Age, sex, amount, and type of memory information in concept learning. Journal of Experimental Psychology, 1967, 73, 121-124.

One-hundred-thirty-five male and 135 female school children, ages 10-18 years were administered the Wisconsin Card Sorting Test in a 4-choice concept-learning task with 3 levels of availability of correct-incorrect alternatives. Females were significantly better under maximum availability conditions, gained more from memory and utilized additional information beyond availability of one instance than males.

Friest, R. F. & Hunsaker, P. L. Compensating for a female disadvantage in problem solving. Journal of Experimental Research in Personality, 1969, 4, 57-64.

Four-hundred-two college undergrads were administered Maier's Horse Trading Problem under one of a variety of administration conditions. Male performance was consistently significantly better than females' under all conditions. Only a combination of more explicit instructions and more time for solution produced significant improvement in female performance.

Roll, S. Sex differences in problem solving as a function of content and order of presentation. Psychonomic Science, 1970, 19, 97.

Forty male and 40 female college psychology students were administered a collection of 20 word problems with equal numbers of masculine role and feminine role problems. Males solved significantly ($p < .05$) more problems than females regardless of male-female content of problems or their order or placement within test booklets.

Very, P. S. Differential factor structures in mathematical abilities. Genetic Psychology Monographs, 1967, 75, 169-207.

Three-hundred-fifty-five college students, ages 18-21 years, were administered a battery of mathematical, verbal and spatial tests. Females scored significantly higher than males on Logical Reasoning. Males scored significantly higher than females on Arithmetic Reasoning and General Reasoning.

Young, M. L. Age and sex differences in problem solving. Journal of Gerontology, 1971, 26, 330-336.

Forty married couples, ages 41-76 years, were compared on a series of problem-solving tasks monitored by an automatic programming machine. Males in their 40's scored higher than females in their 40's. Males in their 50's were more efficient on simpler problems than comparably aged females but the superiority disappeared as problem difficulty increased. There were no significant sex differences between subjects in their 60's and 70's.

PROBLEM SOLVING SUMMARY

Type	Number of Citations Reporting Male Supervisory	No Differences	Female Superiority
Literature Problems	11[α]	4[α]	
Reasoning			
General	1[β]		
Arithmetic	2[β]	1[β]	
Logical	1[β]	1[β]	1

Other: Females superior giving constructional instructions; no differences in following instructions
Females superior in concept learning task
Females used less efficient unorganized strategies or no strategies, guessed, skipped, or gave up in problem solving tasks (2 rpts)
No differences in finding goal by yes-no questions
No differences in finding all possible arrangements of four stimuli

[α]Males superior to age 40, decreases to no difference at age 50
[β]Males superior until math aptitude controlled, then no differences

PSYCHOMOTOR

Boggs, D. H. & Simon, J. R. Differential effect of noise on tasks of varying complexity. Journal of Applied Psychology, 1968, 52, 148-153.

Twenty-four male and 24 female college psychology students performed a "Primary" 4-choice reaction time task, consisting of activating one of four switches in response to one of four light stimuli, and a Secondary task, consisting of an oral response to a sequence of digits presented by earphone to left ear with either silence or bursts of 92dB noise (bandsaw cutting aluminum) between but not interfering with digits. Males were non-significantly faster than females on the Primary task. There were no significant differences on the Secondary task.

Botkin, A. L., Schmaltz, L. W. & Lamb, D. H. "Overloading" the left hemisphere in right-handed subjects with verbal and motor tasks. Neuropsychologia, 1977, 15, 591-596.

Fifty-one male and 51 female right-handed undergrad psychology students performed a motor task with either left or right arm while simultaneously repeating digits backwards. Females repeated significantly ($p < .05$) more digits than males under both left and right arm conditions.

Broverman, D. M., Klaiber, E. L., Kobayashi, Y. & Vogel, W. Roles of activation and inhibition in sex differences in cognitive abilities. Psychological Review, 1968, 75(1), 23-50.

Authors hypothesized that females are superior to males on behaviors involving minimal mediation by higher cognitive processess, typically involving fine coordinations of small muscle groups with attentional and perceptual processes and measured in terms of speed and accuracy of repetitive processes. Males are contrastedly superior on behaviors involving inhibition or delay of initial response to obvious stimulus attributes in favor of less obvious attributes which involve extensive mediation of higher processes, as against automatic or reflexive S-R bonds, and measured in terms of production of solutions to novel tasks or situations. The presence and absence of "sex" steriods tend to support the hypotheses.

Broverman, D. M. & Klaiber, E. L. Negative relationships between abilities. Psychometrika, 1969, 34, 5-20.

Twenty-two males and 30 females, 14-17 years, performed simple perceptual-motor and perceptual-restructuring tasks. Females were superior to males on the perceptual-motor tasks (e.g., color-naming, fine manual dexterity). Males were superior to females on more complex tasks requiring inhibition of response to immediate, obvious stimulus attributes in favor of less immediate, less obvious attributes.

Bucky, S. F., Banta, T. J. & Gross, R. B. Development of motor impulse control and reflectivity. Perceptual and Motor Skills, 1972, 34, 813-814.

Ten males and ten females, white, in each of 4 age groups: 5, 10, 15 and 20 years, tested on Motor Impulse Control (i.e., restraint of motor activity) by Draw-A-Line-Slowly and Walk-A-Line-Slowly, and on Reflectivity (i.e., delay in making response requiring analytic thinking) by Matching Familiar Figures Test and a composit of Embedded Figures Test. No sex differences were found on either Motor Impulse Control or Reflectivity.

Coates, G. D., Kirby, R. H., Eberhardt, N. K. & Miller, S. J. Physiological influences upon the work performance of men and women (Final Technical Report Number 1TR-79-22). Norfolk, VA: Performance Assessment Laboratory, Department of Psychology, Old Dominion University, December 1979. (Contract Grant AFOSR-78-3512, United States Air Force, Air Force Office of Scientific Research)

Ten males from Navy and AF ROTC and 28 female college students using and not using the "Pill" at menstruation or mid-menstrual cycle were tested on Multiple Task Performance Battery during training and sleep loss conditions. No differences were found between male and female groups. Authors caution generalizing results to "real world" job setting because of restricted nature of test tasks.

Coules, J. & Avery, D. L. Human performance and basal skin conductance in a vigilance-type task with and without knowledge of results. Perceptual and Motor Skills, 1966, 23, 1295-1302.

Five male and 5 female college student laboratory assistants and 2 males from laboratory staff performed reaction time task of pressing telegraph key in response to stimulus presented on CRT with and without knowledge of results. Basal skin conductance measured from left middle finger. No sex differences in task performance but skin conductance measures suggest males and females respond differently to knowledge and no knowledge of results.

Droege, R. C. Sex differences in aptitude maturation during high school. Journal of Counseling Psychology, 1967, 14, 407-411.

The U.S. Employment Service 1958 General Aptitude Test Battery was administered to 20,541 students, ages 14-16, in grades 9, 10 and 11 and again in grade 12, age 17, and also to an additional 6,167 students, age 17, in grade 12. Females scored higher than males on motor coordination and finger dexterity.

Duke, J. D. Perception of finger drawings upon the body surface. Journal of General Psychology, 1966, 75, 305-314.

Twenty-five male and 39 female college psychology students were used in a test of a Frontal Plane Hypothesis: Symbols drawn upon anterior and posterior surfaces of the body are perceived as if drawn and viewed upon a common, transparent plane surface projected in front of the subject. A "C", mirror "C", inverted "L" and mirror inverted "L" were each drawn, randomly, by finger on forehead, back of head, small of back and stomach of normally clothed subjects. Significantly more females than males responded in accordance with the hypothesis for forehead ($p < .002$), stomach ($p < .05$) and anterior combined ($p < .05$) drawings.

Eberhardt, N. K. The effect of sleep loss on the rate of gain of information in choice reactions (Interim Technical Report Number ITR-79-21). Norfolk, VA: Performance Assessment Laboratory, Department of Psychology, Old Dominion University, July 1979. (Contract AFOSR-78-3512)

Twelve male and 12 female paid volunteer college students, ages 18-30 years, in equal groups of sleep loss and control, were tested for choice reaction times for sets of 2, 3, 4, 6 and 8 alternative stimuli with oral (by microphone) or manual up to 8 telegraph keys under conditions of practice, 4-hr intervals during 36-hr sleep loss, and after 20-hr post-sleep-loss rest. Females were significantly faster than males in both response modes during initial testing. Sleep-loss females were significantly slower than control females but no significant differences between experimental-control males. (Author suspects "macho" effect due to female data collectors.)

Horn, P. W. Individual consistencies in reminiscence on two motor tasks. Journal of General Psychology, 1976, 94, 271-274.

Thirty male and 30 female college psychology students performed a pursuit rotor task and an inverted alphabet printing task, under no-rest (massed practice of eight 30-sec trials) or rest (3-min rest between 6th and 7th trials) conditions. Males were significantly superior to females on the pursuit rotor ($p < .05$). Females were significantly superior to males on the inverted alphabet printing ($p < .05$).

Huang, K. L. & Payne, R. B. Individual and sex differences in reminiscence. Memory and Cognition, 1975, 3, 252-256.

Forty-two male and 42 female college psychology students were tested on Inverted Alphabet Printing, USAF Rotary Pursuit Test, and Mirror Tracking under balanced orders of task presentation. Females were significantly ($p < .01$) superior to males on Inverted Alphabet Printing; both sexes improved equally. Males were significantly ($p < .025$) superior to females on the Rotary Pursuit and increased their superiority with practice. No significant differences were reported for Mirror Tracking.

Johnson, O. & Kozma, A. Effects of concurrent verbal and musical tasks on a unimanual skill. Cortex, 1977, 13, 11-16.

Nine male and 9 female college students, all right-handed preference, balanced a dowel rod on right or left finger while remaining silent, while speaking, while humming a melody. Speaking decreased balancing times for the right hand in males but made no difference on male left hand performance or either hand for females. Humming had no effect on the performance of either males or females.

Kantor, J. E., Noble, B. E., Leisey, S. A. & McFarlane, T. Air Force female pilots program: Initial performance and attitudes (AFHRL TR 78-67). February 1979. Air Force Human Resources Laboratory.

Twenty-four male instructor pilots, 16 male and 30 female personnel on active duty and reserve, eligible for AF Undergraduate Pilot Training were administered a battery of tests including paper-and-pencil aptitude, psychomotor performance and behavioral samples from flight simulator prior to training. Post-training surveys consisted of peer ratings of abilities and instructor evaluations. Males scored significantly higher than females on pre-training tests of tool functions, electrical maze, and tools, and females scored significantly higher than males on tests of word grouping, tracing and tapping, but there were more similarities than dissimilarities and the correlation between sex and completion of training (.08) was not significant. There was a significant ($p < .01$) difference between instructor's ratings favoring males over females on physical strength and endurance. Instructors also rated males as having more overall pilot potential, greater ability to handle stressful situations in flight and greater overall airmanship. There were no significant sex differences on 28 other comparisons by instructors.

Karlins, M. & Lamm, H. Sex differences and motor task performance. Perceptual and Motor Skills, 1965, 20, 430.

Fifty male and 50 female college students filled circles with X's as rapidly as possible for 50 minutes. There were no significant performance differences between males and females either initially (first 5 minutes) or overall (50 minutes).

Kuechenmeister, C. A., Linton, P. H., Mueller, T. V. & White, H. B. Eye tracking in relation to age, sex, and illness. Archives of General Psychiatry, 1977, 34, 578-579.

Forty normal, 40 schizophrenic and 10 Parkinson patients, ages 20 and up, were measured for eye movements with a differential infrared reflectometric sensor during an eye tracking task. Males were found to be better eye trackers than females.

Linnoila, M., Erwin, C. W., Cleveland, W. P., Logue, P. E. & Gentry, W. D. Effects of alcohol on psychomotor performance of men and women. Journal of Studies on Alcohol, 1978, 39, 745-758.

Ten male and 10 female university students, ages 21-26 years, performed 4 psychomotor tasks under 4 dosages of alcohol (per kg of body weight) or a placebo. Only minor sex differences were found in the effects of alcohol on performance. Females' performances were generally poorer than males'.

McCaffrey, R. J. & Payne, R. B. Interaction of sex and practice distribution effects. Bulletin of the Psychonomic Society, 1977, 10, 382-384.

Twenty-four male and 24 female college students performed a mirror vision tracking task under massed and distributed learning conditions. No sex differences were found.

Noble, C. E. Acquisition of pursuit tracking skill under extended training as a joint function of sex and initial ability. Journal of Experimental Psychology, 1970, 86, 360-373.

Two-hundred-fifty-six male and 244 female college students, ages 17-41 years, trained on the USAF Rotary Pursuit for one hundred 20-sec trails with 10-sec intertrial rests. Males were significantly more accurate and less variable than females.

Noble, C. E., Baker, B. L. & Jones, T. A. Age and sex parameters in psychomotor learning. Perceptual and Motor Skills, 1964, 19, 935-945.

Six hundred subjects, 10 males and 10 females in each of 30 experimental age groups, range 8-87 years, were tested on the USAF Discrimination Reaction Time apparatus. Females demonstrated improvement to age 16, males to age 20, then gradual decline for both. Males performed significantly faster than females.

Noble, C. E. & Hayes, J. R. Discrimination reaction performance as a function of anxiety and sex parameters. Perceptual and Motor Skills, 1966, 23, 1267-1278.

Fifty "high anxiety" males, 50 "low anxiety" males, 50 "high anxiety" and 50 "low anxiety" females were tested on the USAF Discrimination Reaction Timer. High anxiety females were slightly inferior to low anxiety females initially but superior later. High anxiety males were consistently inferior to low anxiety males. Males were significantly ($p < .001$) faster than females.

Noble, C. E. & Noble, C. S. Pursuit tracking skill with separate and combined visual and auditory feedback. Journal of Motor Behavior, 1972, 4, 195-205.

Eighteen male and 18 female undergrad students, ages 17-24 years, were tested on a modified AF Rotary Pursuit Task under conditions of Visual only, Auditory only and Visual plus Auditory feedback. Males were significantly ($p < .01$) superior to females under Visual and Visual plus Auditory feedback conditions but equally poor under Auditory only conditions. The experiment was replicated with an additional 24 male and 24 female undergrad students, ages 18-26 years, with the same results as the first experiment with the differences again being significant ($p < .01$).

Noble, C. E. & Skelley, C. S. Performance of men and women during extended practice in discrimination reaction. Bulletin of the Psychonomic Society, 1976, 8, 241. (Abstract)

Eighty college students performed 240 trials daily for 6 days on the AF Discrimination Reaction Timer. Males and females had similar speeds on the first two days and had similar numbers of errors on each day. Males were significantly ($p < .05$) faster on days 5 and 6 as sexes approached different speed asymptotes.

Parker, D. M. Effects of seasickness on error scores in mirror tracing. Journal of General Psychology, 1969, 81, 147-151.

Thirty-eight male and 38 female volunteer college undergrads traced a five-point star viewed in vertical mirror under control (on dry land) and one of two experimental conditions (on deck or below deck of "wet and tender" sloop at sea). No male-female differences due to sea sickness were found, but while males made fewer errors per second than females when not sick, they made significantly ($p < .01$) more than females when sick.

Payne, R. B. & Huang, K. L. Interaction of sex and task differences in reminiscence. Journal of Motor Behavior, 1977, 9, 29-32.

Forty-two male and 42 female college psychology students performed Inverted Alphabet Printing, AF Rotary Pursuit and Mirror Vision Tracking tasks under one of three task orders (equally balanced). Males performed significantly ($p < .001$) better than females on both rotary pursuit and mirror tracking.

Smith, T. L. The effect of coactors upon the motor performance of male and female subjects of different ages (Doctoral dissertation, Louisiana State University, May 1972) (University Microfilms International, 1977).

Twenty-four white males and 24 white females in each of 3 age groups: 8 years, 13 years and 18 years, performed an accuracy task (dart throw at archery type target) and speed-and-accuracy (dart throw at rectangular target in 30 secs) alone, and in the presence of one or three coactors. Male performance was superior to female's on both tasks. The presence of coactors has no effect on accuracy but improved speed-and-accuracy performance.

Timmons, B. A. Sex as a factor influencing sensitivity to delayed auditory feedback. Perceptual and Motor Skills, 1971, 32, 824-826.

Thirty males and 30 females from the Department of Education, University of Victoria, read 35-word selections from SRA Elementary Reading Laboratory, Grade 9 materials under condition of normal and Delayed Auditory Feedback (with 0.1, 0.2, 0.3, 0.4 and 0.5 sec time delays, randomized). No significant sex differences in reading performance was found but "women tended to adapt significantly more than men."

Weltman, G. & Egstrom, G. H. Perceptual narrowing in novice di\ s. Human Factors, 1966, 8, 499-506.

Fifteen male and female recruits from UCLA Scuba diving class, ages 20-36 years, performed a Central task, consisting of mental addition and dial monitoring, and a Peripheral task, consisting of response to a light on left side within standard diving mask under 3 conditions: On land, underwater in diving tank, and underwater in open ocean. Male performance of the peripheral task on the surface was significantly ($p < .02$) faster than female's. Females worked significantly fewer addition problems than males on the surface ($p < .03$) and in the tank ($p < .07$) and did not-significantly worse on dial monitoring on the surface but significantly ($p < .05$) worse in the tank (no open ocean comparisons were made due to too few females.)

PSYCHOMOTOR SUMMARY

Type	Number of Citations Reporting		
	Male Superiority	No Differences	Female Superiority
Rotary Pursuit	6		
Mirror Tracing	1	3	
Simple Reaction Time	1	1	
Complex Reaction Time	3	1	1
Delayed Response	1	1	
Inverted Alphabet		1	2
Speech-Motor Conflict Resistance			2

PERCEPTION-DISCRIMINATION

Allen, D. B. & Rudy, K. P. Perception of simple figures drawn upon the body surface. Perceptual and Motor Skills, 1970, 30, 369-370.

Sixty-two male and 41 female "available" subjects, ages 12-48 years, were utilized. Four simple figures were traced on subject's forehead and on back of subjects' head. Subject reproduced the figure on a surface. No sex differences were found, males reproducing the forehead figures 83.9% with no or one error and females reproducing 87.8%, males reproducing back of head figures 93.6% correct, females 97.6%.

Bakan, P. & Manley, R. Effect of visual deprivation on auditory vigilance. British Journal of Psychology, 1963, 54, 115-119.

Forty-four male and 44 female undergrad students performed an auditory vigilance signal detection (three different digits, odd-even-odd in a continuous series of digits) task under normal vision and visual deprivation (blindfolded). Visual deprivation had no significant effect on female performance but a significant ($p < .05$) positive effect on male performance.

Bakan, P. & Putnam, W. Right-left discrimination and brain lateralization: Sex differences. Archives of Neurology, 1974, 30, 334-335.

One-hundred-twenty-three right-handed male, 28 left-handed male, 228 right-handed female and 21 left-handed female college undergrads were administered the Culver Lateral Discrimination test in which subjects viewed slides of right or left body parts and identified as right or left. Males were significantly superior to females on the number of correct discriminations.

Burgess, M. M. & Hokanson, J. E. Effects of autonomic arousal level, sex and frustration on performance. Perceptual and Motor Skills, 1968, 26, 919-930.

One-hundred-seventy-six (no sex or source identification) subjects, 18-24 years of age, were administered a symbol matching task. Device consisted of a series of symbols with lights above on the upper part of a display board. Symbols were repeated, not in same order, on lower part of board with adjacent response buttons. A separate subject-operated stimulus button lighted an upper stimulus symbol. Subject found same symbol among lower row and pressed adjacent button. Scored on number of correct matches in one minute. No sex differences were found.

Cancro, R. & Voth, H. M. Autokinesis and psychological differentiation. Perceptual and Motor Skills, 1969, 28, 99-103.

Twenty-eight male and 77 female volunteers from community, mean age 25.8 years, were administered the Hidden Figures Test, Rod and Frame Test and an autokinetic test. No significant differences were found between male and female autokinetic scores.

Chaplin, J. P. Sex differences in the perception of autokinetic movement. Journal of General Psychology, 1955, 52, 149-155.

Two experiments reported. Experiment I utilized 32 male and 27 female undergrad psychology students. A circle, three different sized rectangles and 3 corresponding sized arrows in 4 directional attitudes were presented in a light-proof box. Subject activated a switch as soon as (autokinetic) movement was noted and recorded on paper direction and extent of movement. Males' response time to detect movement was significantly ($p < .05$) faster than females'. Males detected significantly ($p < .01$) greater movement than females. Females gave 13% more reports of no movement than males. Experiment II utilized 20 male and 24 female undergrad psychology students in a procedure similar to Experiment I, except that the circle and largest and smallest rectangles were excluded and subjects reported orally the commencement and direction of movement. The same sex differences were found as in Experiment I. The majority of males believed stimuli actually moved, some even after illusion explained. The majority of females realized movement to be illusory after a few trials.

Coates, G. D., Kirby, R. H., Eberhardt, N. K. & Miller, S. J. Physiological influences upon the work performance of men and women (Final Technical Report Number ITR-79-22). Norfolk, VA: Performance Assessment Laboratory, Department of Psychology, Old Dominion University, December 1979. (Contract Grant AFOSR-78-3512, United States Air Force, Air Force Office of Scientific Research)

Ten male and 28 female college students were utilized in a complex study of the effects of work, sleep loss, menstrual cycle and use of "the pill" on Multiple Task Performance Battery performance including a variety of vigilance, mental arithmetic and procedural tasks. The authors generalize that female performance was equivalent to that of males under all conditions of training, base line and stress.

Conklin, R. C., Muir, W. & Boersma, F. J. Field dependency-independency and eye-movement patterns. Perceptual and Motor Skills, 1968, 26, 59-65.

Sixteen male and 16 female college freshman selected on the basis of extreme high or low scores on the Gray Embedded Figures test were given up to 20 seconds to identify the subject of each of three indistinct pictures. No significant sex differences were found.

Davies, A. D. M. The perceptual maze test in a normal population. Perceptual and Motor Skills, 1965, 20, 287-293.

Fifty males and 40 females in each age decade group 20-29 to 70-79 were administered 18 Perceptual Maze tests, two each of 3 maze sizes and 3 saturation levels. Males scored significantly ($p < .01$) more mazes correctly than females in all age groups except the upper two where male superiority was not significant ($p > .05$).

Drinkwater, B. L. Speed and accuracy in decision responses of men and women pilots. Ergonomics, 1968, 11(1), 61-67.

Thirty-six males and 18 females, ages 24-65 years, holding commercial or private pilot licenses were presented 30 slides showing line drawings of three pilot instruments showing indications requiring pilot evaluation. Subjects were required to press one of two keys indicating whether instruments were in agreement or not in agreement. No significant differences were found between males and females. There was a tendency for females to be slower but more accurate than males initially and males to be faster but less accurate initially, with performances to approach equality over time.

Droege, R. C. Sex differences in aptitude maturation during high school. Journal of Counseling Psychology, 1967, 14, 407-411.

The U.S. Employment Service 1958 General Aptitude Test Battery was administered to 20,541 students, ages 14-16 years, in grades 9, 10 and 11 and retested at age 17 in grade 12 and was also administered to additional 6,167 students, age 17, in grade 12. In every comparison females scored higher than males in verbal aptitude, form perception, clerical perception, motor coordination and finger dexterity.

Duke, J. D. Perception of finger drawings upon the body surface. Journal of General Psychology, 1966, 75, 305-314.

Twenty-five male and 39 female college psychology students were used in a test of the Frontal Plane Hypothesis that symbols drawn on the anterior and posterior surfaces of the body are perceived as if drawn and seen on a transparent plane in front of the subject. A "C", mirror image "C", inverted "L" and a mirror image inverted "L" were randomly drawn by finger on the forehead, back of head, small of back and stomach of subjects who drew symbol on paper. Significantly more females than males responded in accordance with the hypothesis for forehead drawings ($p < .002$), stomach ($p < .05$) and combined anterior drawings ($p < .05$), with no significant differences for posterior drawings.

Elias, M. F. & Kinsbourne, M. Age and sex differences in the processing or verbal and nonverbal stimuli. Journal of Gerontology, 1974, 29, 162-171.

Five males in each of two age groups, young (22-33 years) and old (63-77 years) and 5 females in each of the two age groups were required to match two successive visual stimuli on the basis of membership in binary sets. In one condition the stimuli were verbal and the other condition non-verbal. Females made significantly more errors with nonverbal stimuli than on verbal stimuli or than males did with either verbal or nonverbal stimuli.